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SUMMARY OF ANNUAL WAVE POWER FOR TEN DEEP WATER STATIONS ALONG THE CALIFORNIA, OREGON & WASHINGTON COASTS

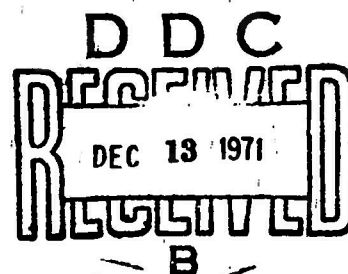
by

J. W. JOHNSON

J. T. MOORE

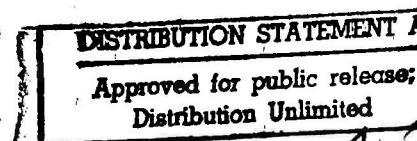
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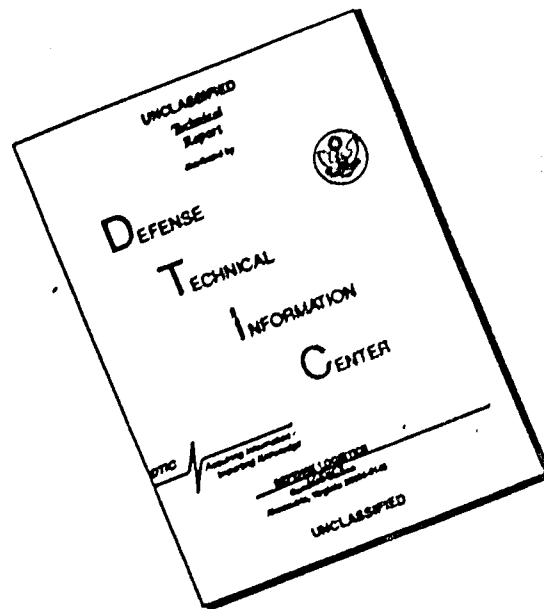


HYDRAULIC ENGINEERING LABORATORY
COLLEGE OF ENGINEERING

UNIVERSITY OF CALIFORNIA
BERKELEY
OCTOBER, 1971



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Technical Report HEL-24-9

SUMMARY OF ANNUAL WAVE POWER
FOR
TEN DEEP WATER STATIONS
ALONG THE
CALIFORNIA, OREGON, AND WASHINGTON COASTS

by

J. W. Johnson
J. T. Moore
E. B. Orrett

This compilation was completed on research projects on coastal inlets (Contract DACW 72-71-C-005) and nearshore sediments (Contract 72-67-C-0015) with the Coastal Engineering Research Center, Corps of Engineers, U.S. Army.

Berkeley, California

October 1971

ERRATA

Technical Report HEL-24-9

For Figures A-1 to A-11, inclusive, multiply swell power values by 1.15

"	"	A-12 to A-22,	"	"	"	"	"	"	1.18
"	"	A-23 to A-32,	"	"	"	"	"	"	1.17
"	"	A-33 to A-42,	"	"	"	"	"	"	1.15
"	"	A-43 to A-55,	"	"	"	"	"	"	1.10
"	"	A-56 to A-66,	"	"	"	"	"	"	1.29
"	"	A-67 to A-79,	"	"	"	"	"	"	0.93
"	"	A-80 to A-90,	"	"	"	"	"	"	1.22
"	"	A-91 to A-101	"	"	"	"	"	"	1.19
"	"	A-102 to A-112	"	"	"	"	"	"	1.18
"	"	B-1 to B-10	"	"	"	"	"	"	1.51
"	"	B-11 to B-20	"	"	"	"	"	"	1.31
"	"	B-21 to B-30	"	"	"	"	"	"	1.49
"	"	B-31 to B-38	"	"	"	"	"	"	1.02
"	"	B-39 to B-48	"	"	"	"	"	"	1.02
"	"	B-49 to B-54	"	"	"	"	"	"	0.86
"	"	B-55 to B-60	"	"	"	"	"	"	0.67
"	"	B-61 to B-66	"	"	"	"	"	"	0.77
"	"	B-67 to B-73	"	"	"	"	"	"	1.13
"	"	B-74 to B-80	"	"	"	"	"	"	1.42
"	"	B-81 to B-87	"	"	"	"	"	"	1.40
"	"	B-88 to B-95	"	"	"	"	"	"	1.51

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INTRODUCTION

The most important factor in shaping a shoreline and establishing the characteristics of beaches is the intensity of the wave attack. Rocky shorelines change very little over several hundreds of years as a result of wave action. The sandy portions of a shoreline (beaches), however, may undergo changes in a matter of even a few hours as a result of changing wave conditions. Beaches which are subjected to waves from a variety of directions and of a variety of heights and periods are much more complex in both plan and profile than beaches which are affected by less variable wave conditions. Basic to an appraisal of the characteristics of shore processes in a given locality is adequate information on the wave climate.

Wave statistics for ten locations along the Pacific Coast (California, Oregon, and Washington) were compiled in 1960 by the National Marine Consultants for the Corps of Engineers*. These deep water wave statistics were compiled by the hindcast procedure using meteorological records and charts for the years 1956, 1957, and 1958. The statistics compiled were wave height, wave direction, and wave period for both "sea" and "swell" and were presented as monthly and annual averages. The locations of the ten stations are shown in Figs. 1 and 2 and are:

California Coast

Station 1	42.0° N, 125.0° W
Station 2	39.6° N, 124.5° W
Station 3	37.6° N, 123.5° W

* See references 1 and 2.

Station 4	35.5° N, 122.0° W
Station 5	34.5° N, 121.0° W
Station 6	34.2° N, 120.0° W
Station 7	33.5° N, 119.5° W

Oregon-Washington Coast

Station 1	44° 40'N, 124° 50'W
Station 2	46° 12'N, 124° 30'W
Station 3	47° 40'N, 125° 00'W

The meteorological aspects of the wave regime of the Pacific Coast, choice of hindcast years, and hindcast methods are fully explained in the reports (1,2). The statistical summaries are presented both in tabular and rose form.

The data summarized in this report pertain to deep water. To apply the data for any one of the ten stations to a nearby location at or near the shore would require, of course, a consideration of refraction and shoaling effects to arrive at the annual power acting at the inshore location.

WAVE POWER

The calculations for the wave power per foot of wave crest is based on the following relationships:

$$E = \text{Wave energy per unit width of crest} = \frac{\gamma H_o^2 L_o}{8}$$

where:

$$\gamma = \text{Unit weight of sea water} = 64 \text{ lbs/ft}^3$$

$$H_o = \text{Deep water wave height, ft.}$$

$$L_o = \text{Deep water wave length, ft.}$$

$$= gT^2/2\pi = 5.12 T^2$$

$$T = \text{Wave period, sec.}$$

$$g = \text{acceleration of gravity}$$

In deep water,

$$\text{Wave power, } P = \frac{E}{2T}$$

$$\text{or } P = \frac{(64) (5.12) T^2 H_o^2}{16 T}$$

$$P = 20.5 H_o^2 T = \text{ft lbs/sec/ft} \quad (1)$$

To obtain the total power for a year would involve multiplication of power, P , by the percentage of time that a wave with a given height and period occurs by the number of seconds in a year; that is,

$$\begin{aligned} \text{Total power per year} &= P(\% \text{ of time}) (365.33 \times 24 \times 3600^*) \\ &= P(\% \text{ of time}) (3.17 \times 10^7) = \text{ft lbs/ft/year} \end{aligned} \quad (2)$$

WAVE STATISTICS

The annual wave power for the ten deep water stations along the California, Oregon, and Washington coasts were calculated, tabulated, and summarized in graphical form in laboratory reports (3,4). The proceedings involved in this compilation is illustrated as follows for one of the stations.

Table 1 shows the average annual height-period-direction frequency distribution (per cent) of sea and swell for Station 3 which is located in deep water west of San Francisco. This summary is typical of all ten stations along the Pacific Coast (Figs. 1 and 2) (3, 4). For each wave direction shown in Table 1 a tabulation of per cent of

*In the case of Sea the total seconds per year when the category of calm is included is 3.17×10^7 . For Swell, where more than one wave train can exist, the total hours (or seconds) per year varies among the ten stations (for example, see footnote, Table 2, for Station 3).

time was made that wave heights of 2,4,... 16 ft. occurred for wave periods of 7,9,... 17 sec. for both sea and swell. Such data are shown in Table 2 for Station 3 as derived from Table 1. The wave power in foot pounds per foot of wave crest per year for the various periods and wave heights was then calculated by Eq. 2* and tabulated. The total power for each wave period and direction was calculated, tabulated, and plotted as illustrated for the NNW direction in Fig. 3. This procedure was repeated for all nine of the directions (SSE to NNW) shown in Table 1. Figure 3 clearly illustrates the relative contribution of wave power for various periods of both sea and swell. A summary plot of annual wave power for all nine directions for sea and swell is shown by the bar graph in Fig. 4. Plots similar to Figs. 3 and 4 for all ten Pacific Coast stations are shown in Appendix A.

SEASONAL VARIATION OF WAVE POWER

The deep water data for Station 3 (California) was broken down and further analyzed on a monthly basis (5). Wave power was computed in the same manner previously described except for a change in the time constant (seconds per month used instead of seconds per year)**. The calculated results are presented on graphs of wave power vs. period for all months and directions and on bar charts for each month showing power vs. direction. These graphs are presented in Appendix B.

* Seconds per year for Swell was 3.7×10^7 .

** For Sea, seconds per month varies with the days in the month. For Swell, the number of seconds per month depends on the average number of wave trains in existence during the three years of hindcast.

REFERENCES

1. Wave statistics for seven deep water stations along the California coast, prepared for the U. S. Army Corps of Engineers Districts, Los Angeles and San Francisco. National Marine Consultants, December 1960.
2. Wave statistics for three deep water stations along the Oregon-Washington coast, prepared for the U. S. Army Corps of Engineers Districts, Seattle and Portland. National Marine Consultants, May 1961.
3. Annual wave power, seven deep water stations along the California coast, by Jon T. Moore and Edwin B. Orrett, Univ. of Calif. Hydraulic Engineering Laboratory Report, Berkeley, August, 1971.
4. Annual wave power, three deep water stations along the Oregon-Washington coast, by Jon T. Moore and E. B. Orrett, Univ. of Calif. Hydraulic Engineering Laboratory Report, Berkeley, August, 1971.
5. Monthly wave power of sea and swell, Station 3, California Coast, by Jon T. Moore and E. B. Orrett, Univ. of Calif. Hydraulic Engineering Laboratory Report, Berkeley, August, 1971.

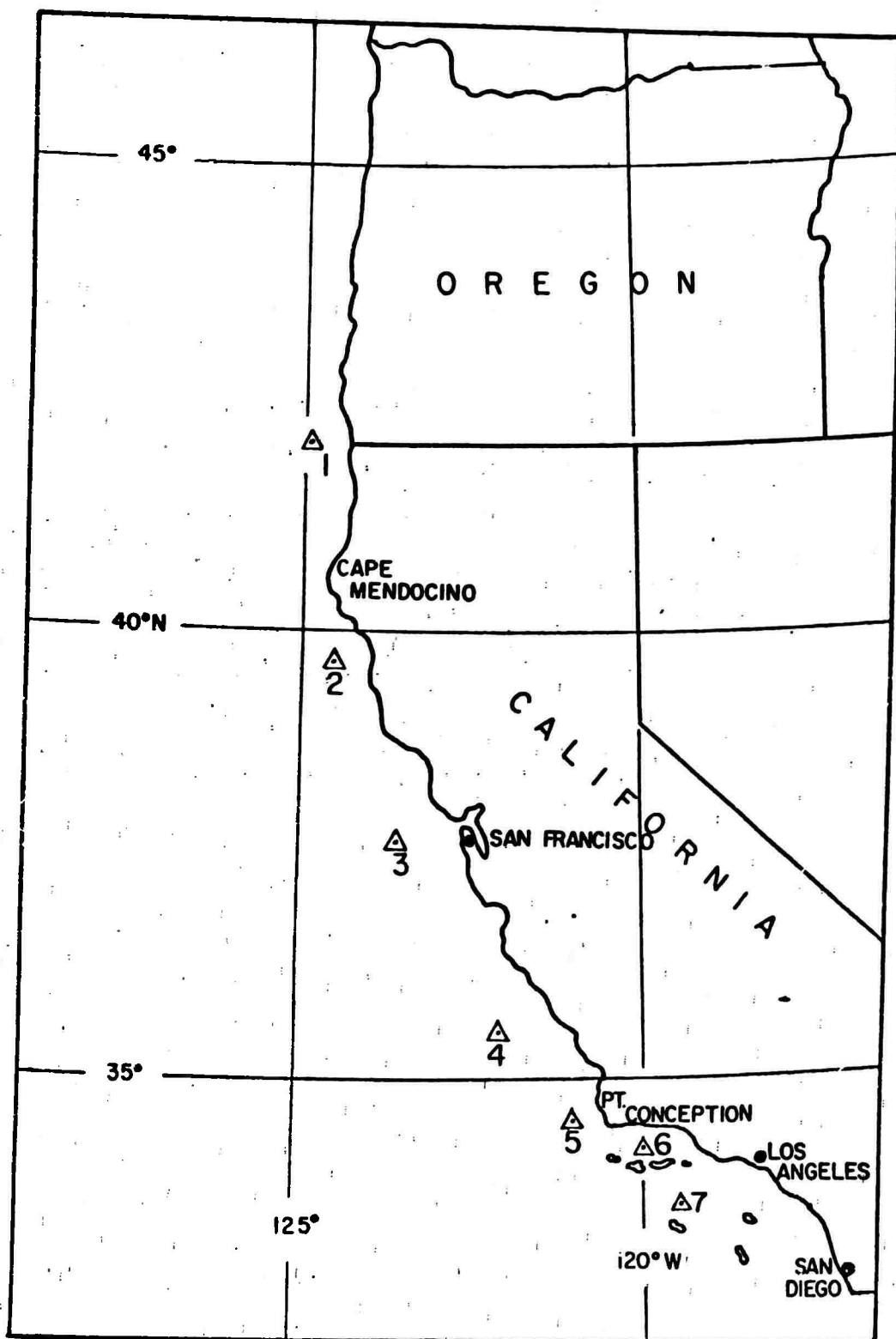


Fig. 1. Locations of hindcast stations along the California coast (From Ref. 1).



Fig. 2. Locations of hindcast stations along the Oregon and Washington coasts (From Ref. 2).

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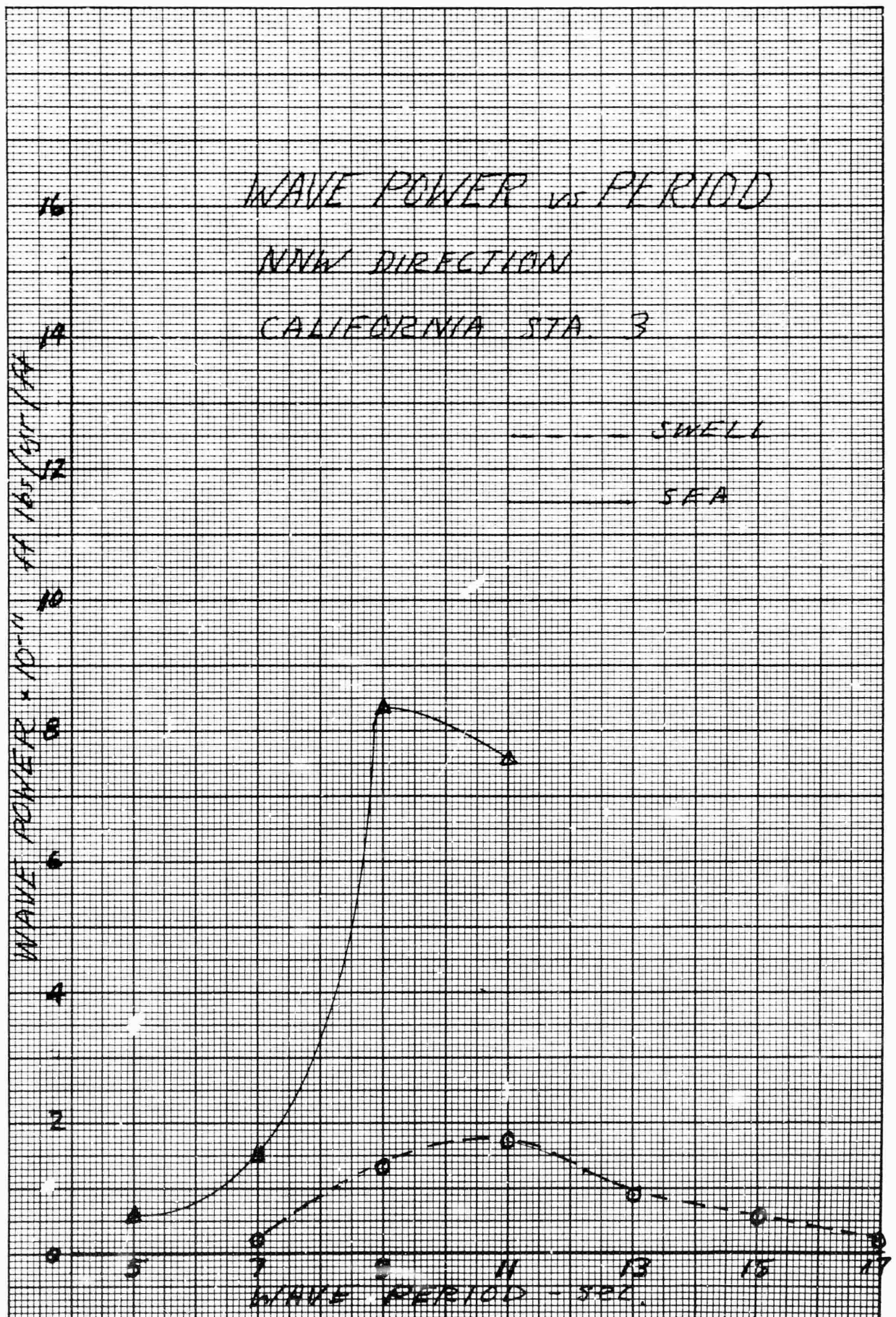


Fig. 3

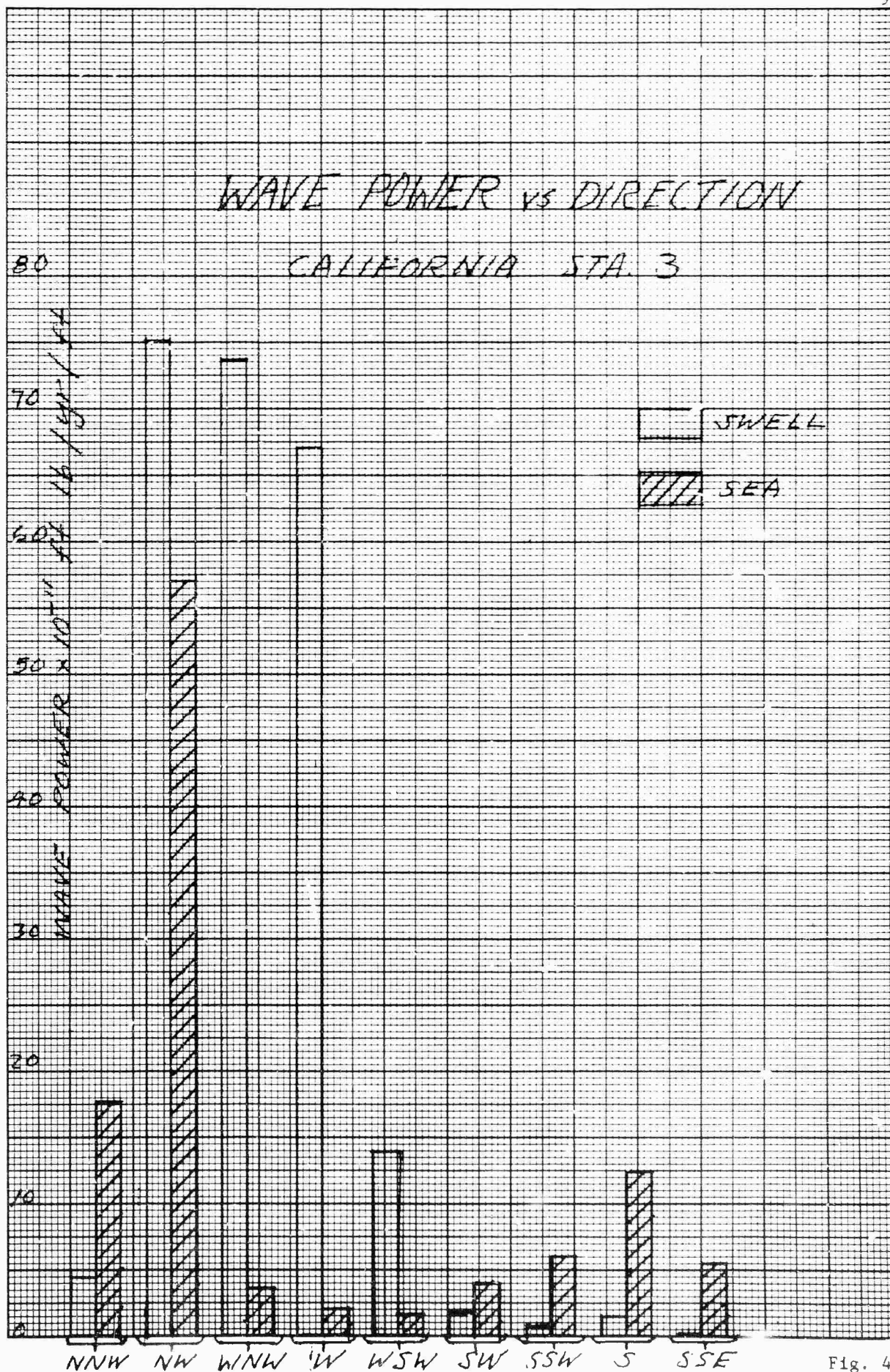


Fig. 4

TABLE 1

AVERAGE ANNUAL HEIGHT-PERIOD-DIRECTION FREQUENCY DISTRIBUTION (PERCENT)¹ STATION 3 (1946, 1947, 1948)

SWELL AVERAGE TOTAL HOURS 1.1

DIR.	NNW			NN			NNE			N			NSE			NE			NNE			S			SSE			Σ	
	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16		18
T _h	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	+
H _h	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	6	8	10	12	14	16	18	+
1-2.9	43	96	17	13	02	05	28	79	68	41	15	02	09	09	02	09	09	09	09	09	09	09	09	09	09	09	09	52.03	
3-4.9	12	49	29	16	07	05	159	58	28	12	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	33.41	
5-6.9	16	42	12	02			07	193	20	10	07	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	09	16.93	
7-8.9	02	07	02				43	80	52	27	07	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	6.71	
9-10.9							07	09	24	27	09	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	28.4	
11-12.9							02	17	24	07	07	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	8.2	
13-14.9							10	25	07			05	09	07	02	02	02	02	02	02	02	02	02	02	02	02	02	3.6	
15-16.9							02	02	02			05	10	02	02	02	02	02	02	02	02	02	02	02	02	02	02	2.5	
17-18.9							07					05	09	02	02	02	02	02	02	02	02	02	02	02	02	02	02	1.5	
19-20.9							02					02			02	02	02	02	02	02	02	02	02	02	02	02	02	0.9	
21-22.9												05	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	0.9	
23-24.9												05	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	0.9	
25-26.9												05	02	02	02	02	02	02	02	02	02	02	02	02	02	02	02	0.9	
27 +	55	163	12	43	18	10	44	82	45	43	23	40	04	46	43	88	50	27	16	37	18	20	04	15	20	17	31	117.00	

SEA

DIR.	N			NNW			NN			NW			N			NE			E			SE			OFFSHORE	CALC ²	Σ					
	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10				12				
T _h	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	4	6	8	10	12	+						
H _h	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+	6	8	10	12	+							
1-2.9	02					11.7	52.02				98.02				240.12																	84.72
3-4.9	02	02				50.2	05				199.12	23																				26.49
5-6.9	02		79	33		50.2	05				517.04																					7.03
7-8.9											09.57																					9.91
9-10.9						31.1					122.13																					2.27
11-12.9						22.43					04.26																					1.29
13-14.9											3.5																					6.1
15-16.9						09																										3.4
17-18.9																																0.2
19 +																																
Σ	04	04				28.57	222.7				514.58	18																				2724

1 Based on 365-1/3 Days

2 Includes waves of 0 to 0.9 feet

TABLE 2. ANNUAL WAVE POWER: SEA AND SWELL
CALIF. STA. 3, NNW

T (sec)	H ₀ = 2'			H ₀ = 4'			H ₀ = 6'			H ₀ = 8'			H ₀ = 10'			H ₀ = 12'			H ₀ = 14'		
	% time	sec/year x 10 ⁻⁷	P	% time	sec/year x 10 ⁻⁷	P	% time	sec/year x 10 ⁻⁷	P	% time	sec/year x 10 ⁻⁷	P	% time	sec/year x 10 ⁻⁷	P	% time	sec/year x 10 ⁻⁷	P	% time	sec/year x 10 ⁻⁷	P
7	.43	1.60	0.91x10 ¹⁰	.12	0.45	1.04x10 ¹⁰	.16	0.59	3.86x10 ¹⁰	.02	0.074	0.89x10 ¹⁰	.07	0.26	5.80x10 ¹⁰						
9	.86	3.36	2.62x10 ¹⁰	.49	1.82	5.50x10 ¹⁰	.12	0.45	3.86x10 ¹⁰	.07	0.26	3.78x10 ¹⁰									
11	.17	0.63	5.72x10 ⁹	.29	1.08	3.89x10 ¹⁰	.12	0.45	4.28x10 ¹⁰	.02	0.074	1.26x10 ¹⁰									
13	.13	0.48	5.18x10 ⁹	.16	0.59	2.54x10 ¹⁰	.09	0.33	3.71x10 ¹⁰												
15	.02	0.074	0.91x10 ⁹	.07	0.26	1.29x10 ¹⁰															
17	.05	0.185	2.80x10 ⁹	.05	0.18	1.04x10 ¹⁰															
18+																					
SEA**																					
5	2.18	6.91	2.64x10 ¹⁰	.58	1.84	3.02x10 ¹⁰	.79	2.31	1.37x10 ¹⁰				.31	.983	1.98x10 ¹¹	.02	.0835	1.70x10 ¹⁰			
7	.09	.285	1.64x10 ⁹	.239	7.58	1.74x10 ¹⁰	.33	1.045	7.02x10 ¹¹	1.1	4.78	5.60x10 ¹¹	.17	.539	1.22x10 ¹¹	.48	1.425	4.65x10 ¹¹	.09	.285	1.99x10 ¹¹
9				.05	.1385	4.66x10 ⁹															
11																					
12+																					
SWELL																					
7																					
9																					
11																					
13																					
15																					
17																					
18+																					
SEA**																					
5																					
7																					
9																					
11																					
12+																					

* For Swell, the total number of seconds per year is 10,258,56 x 3600 = 3.7 x 10⁷.
 ** For Sea, the total number of seconds per year is 365.33 x 24 x 3600 = 3.17 x 10⁷.

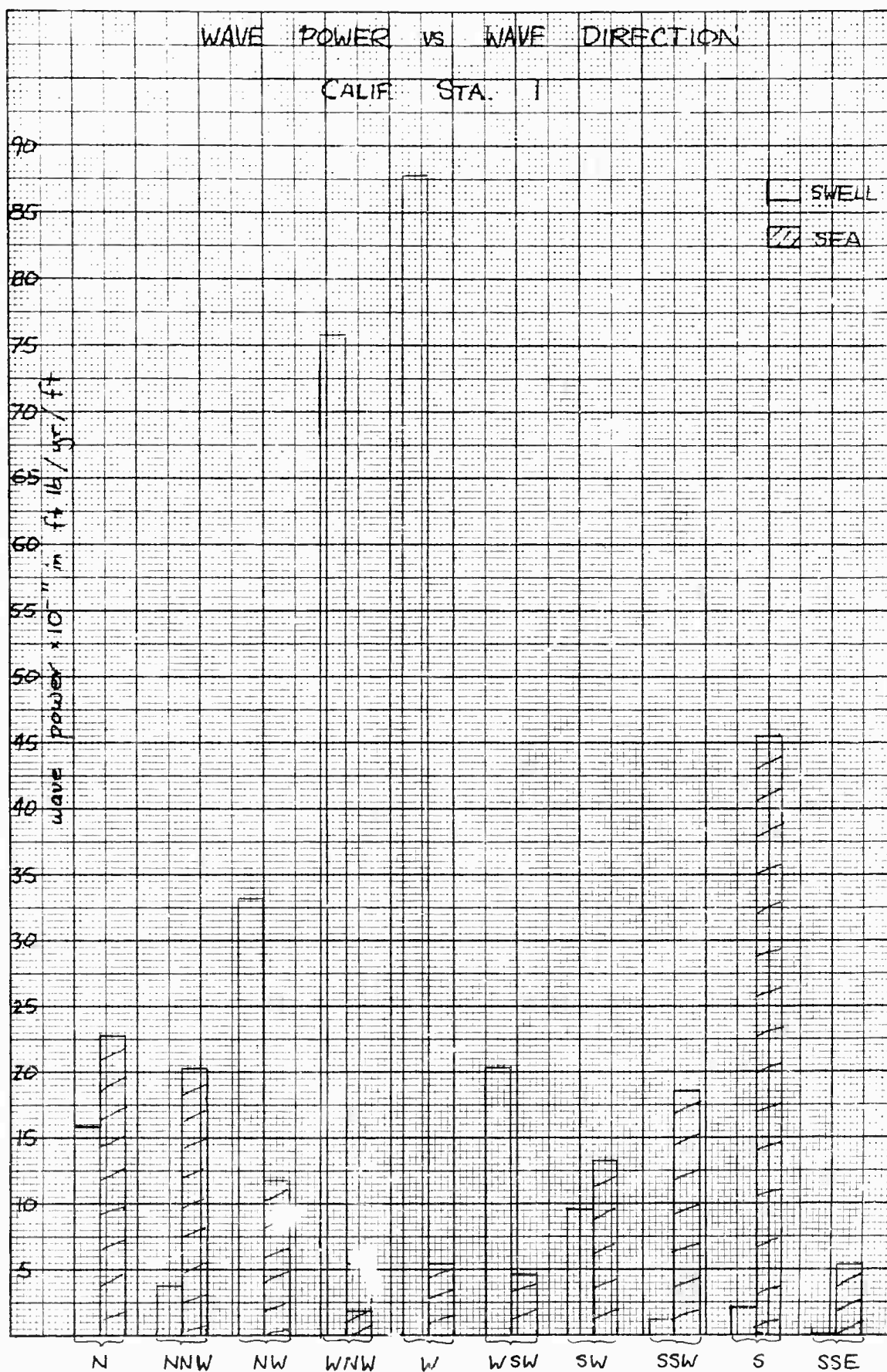
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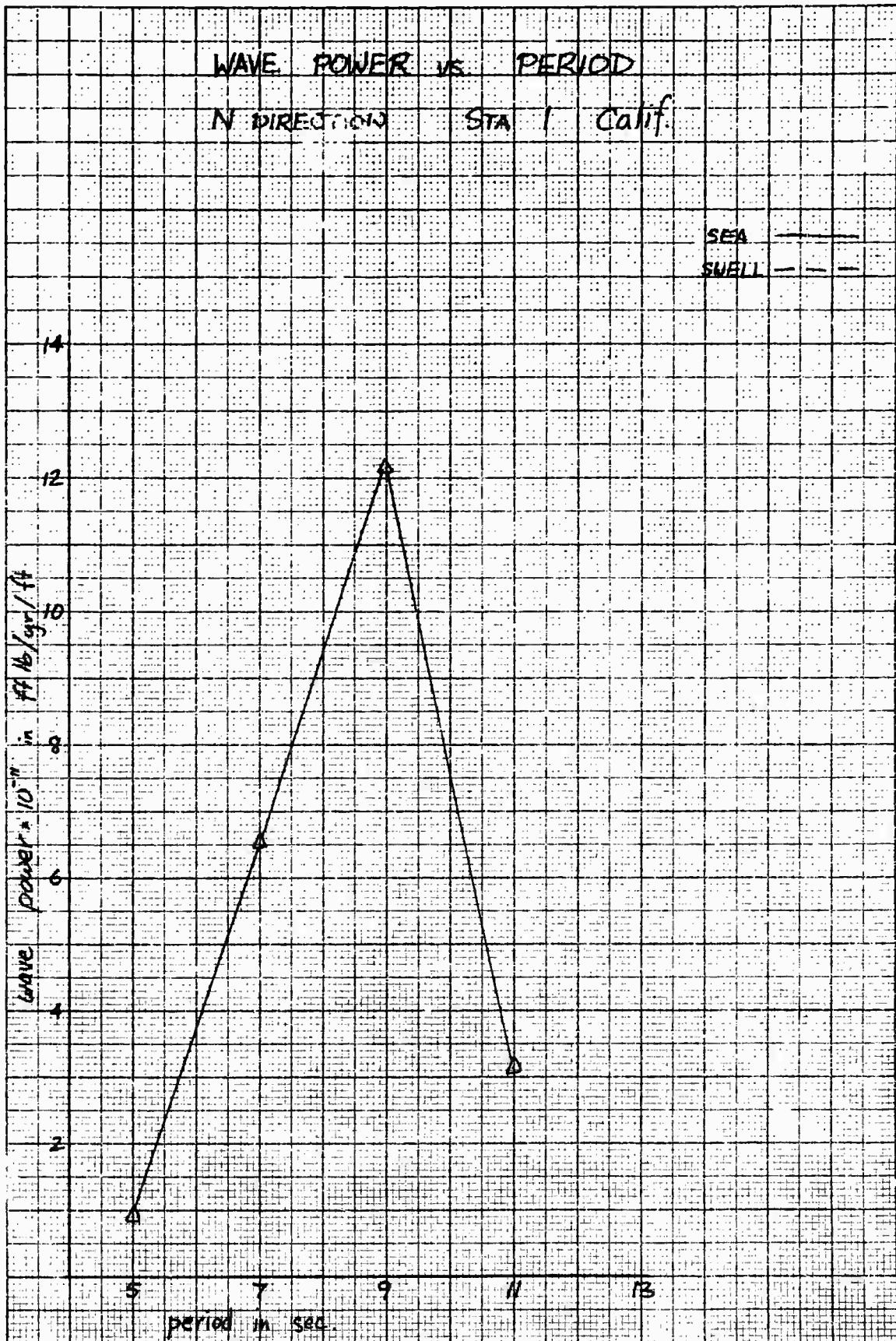
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STATION 1 - CALIFORNIA COAST

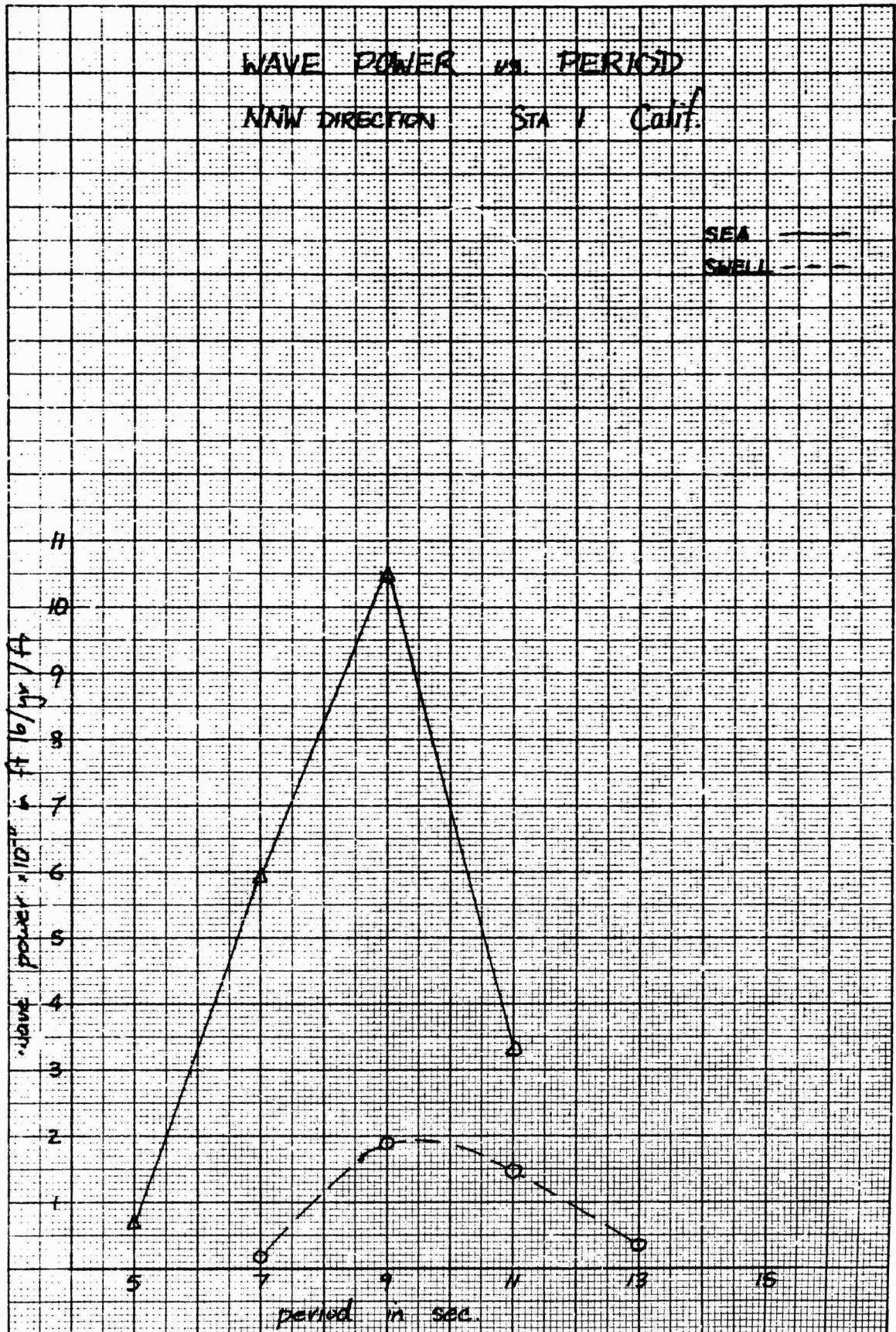
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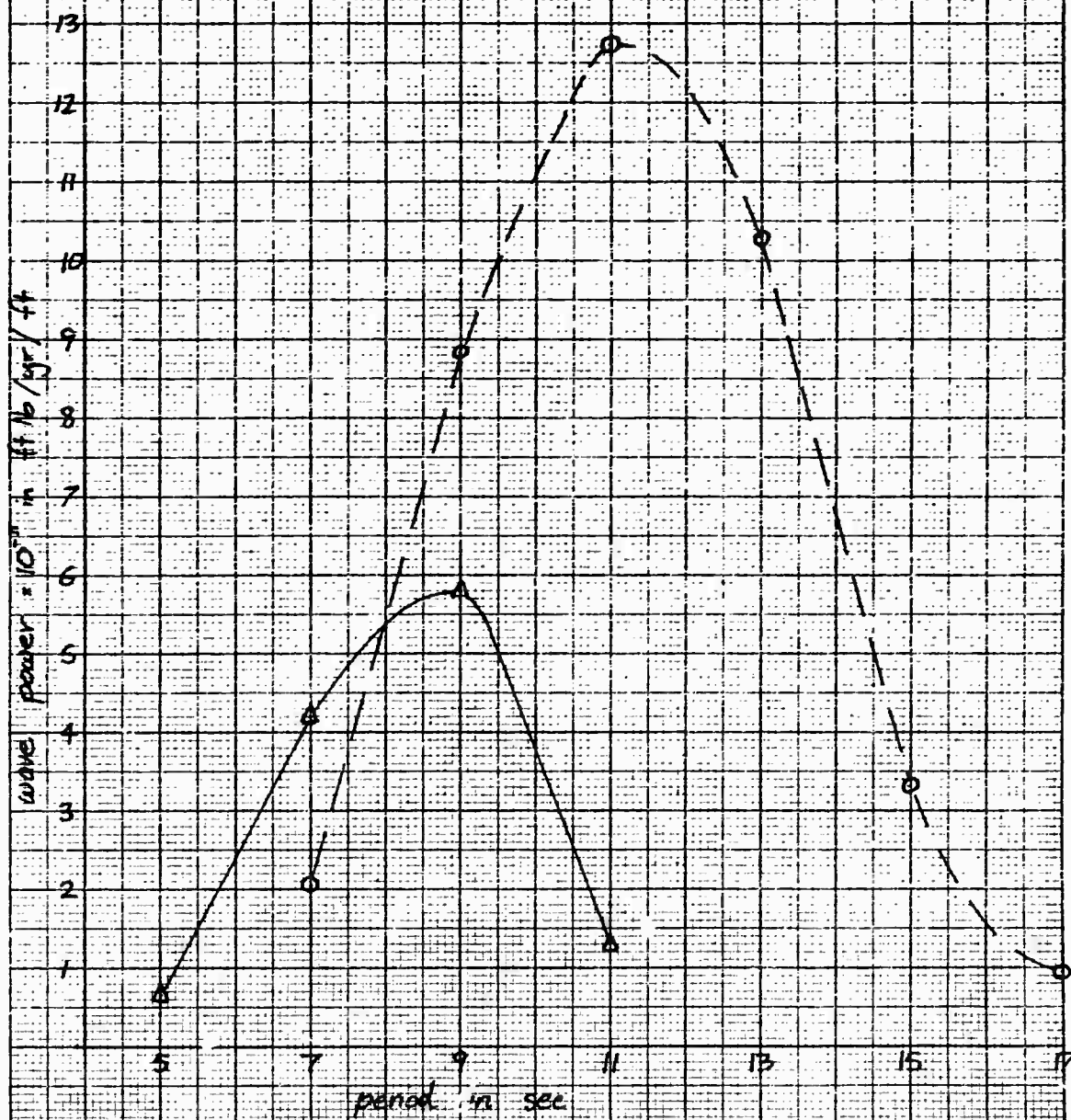


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WAVE POWER vs. PERIOD
NW DIRECTION STA 1 Calif

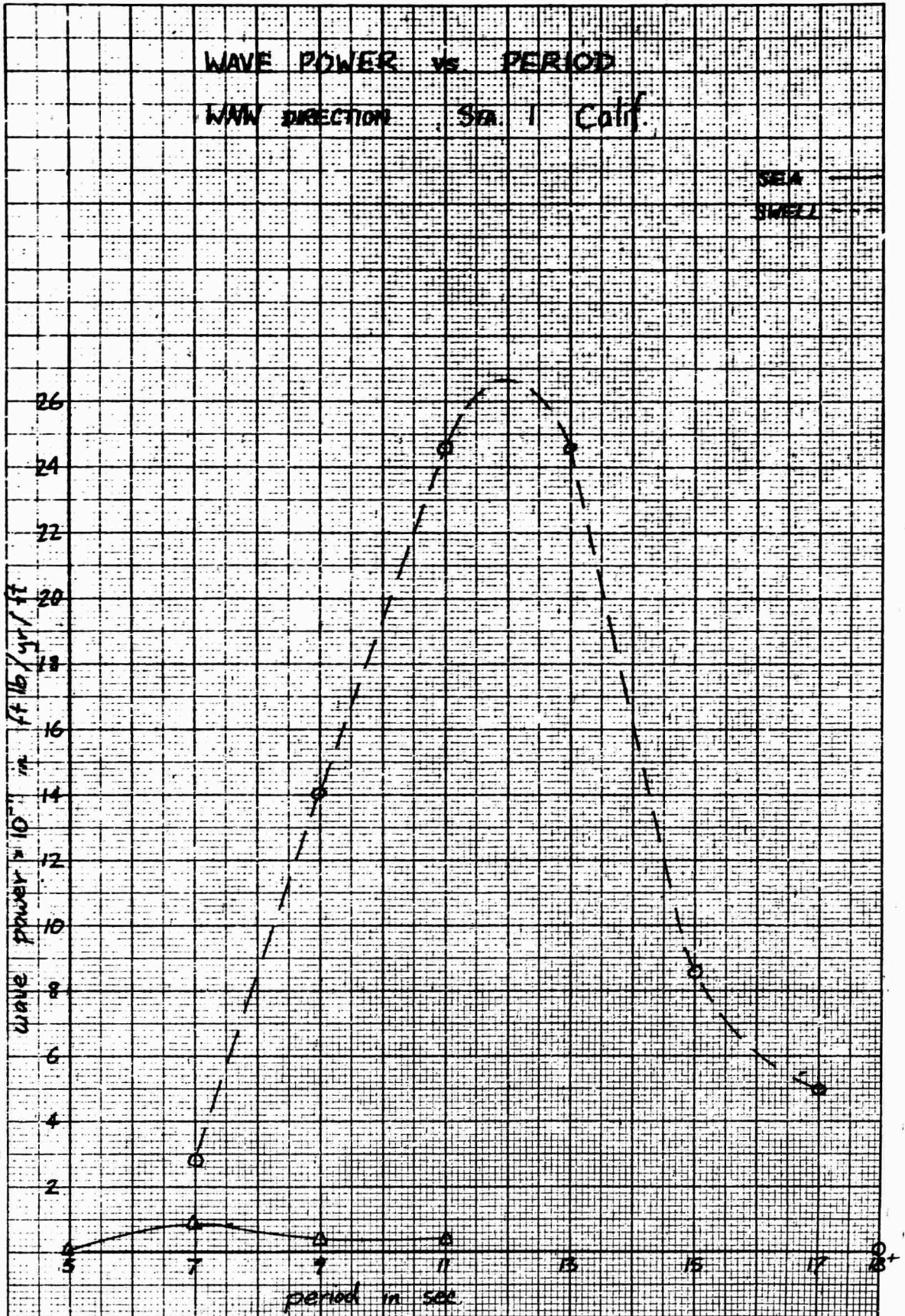
SEA ———
SWELL - - -



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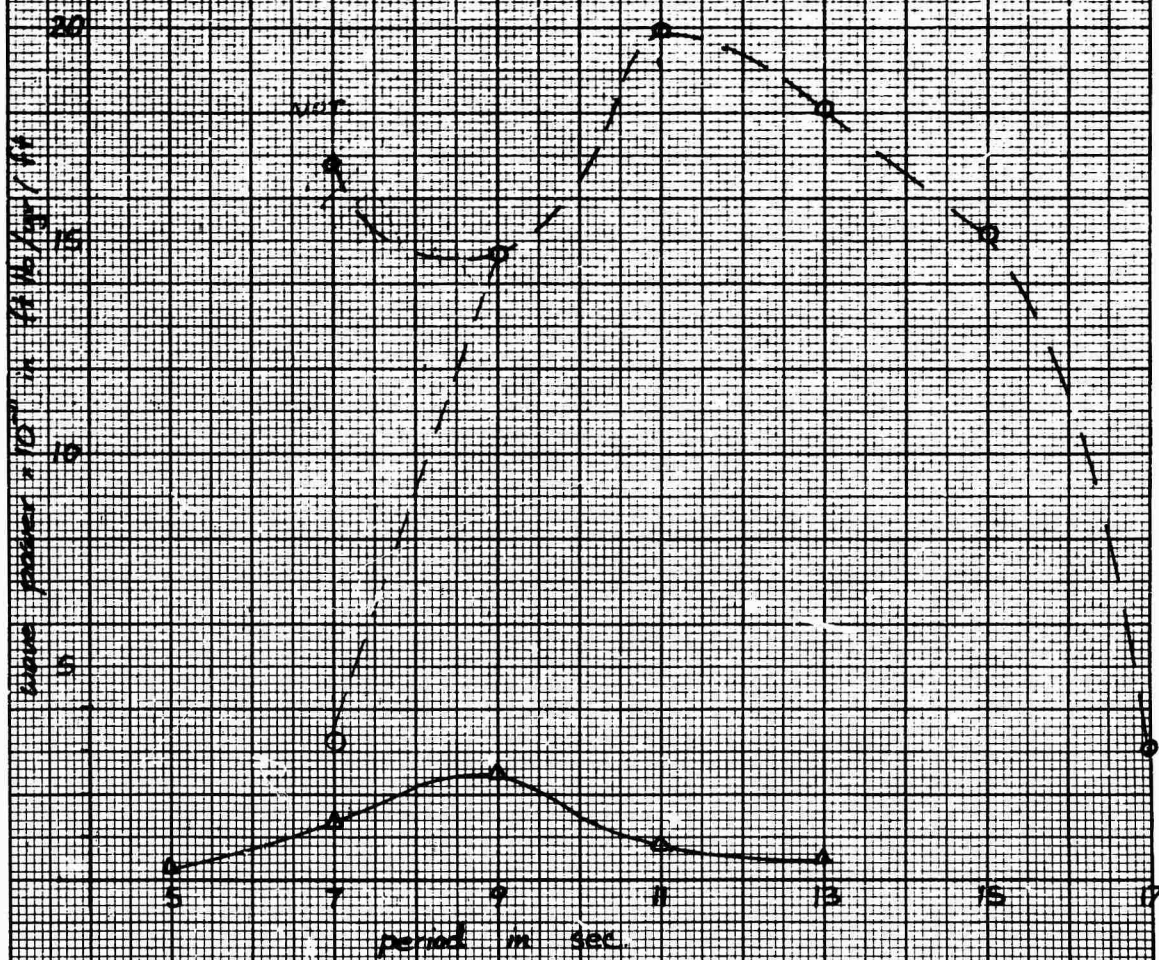


WAVE POWER vs. PERIOD

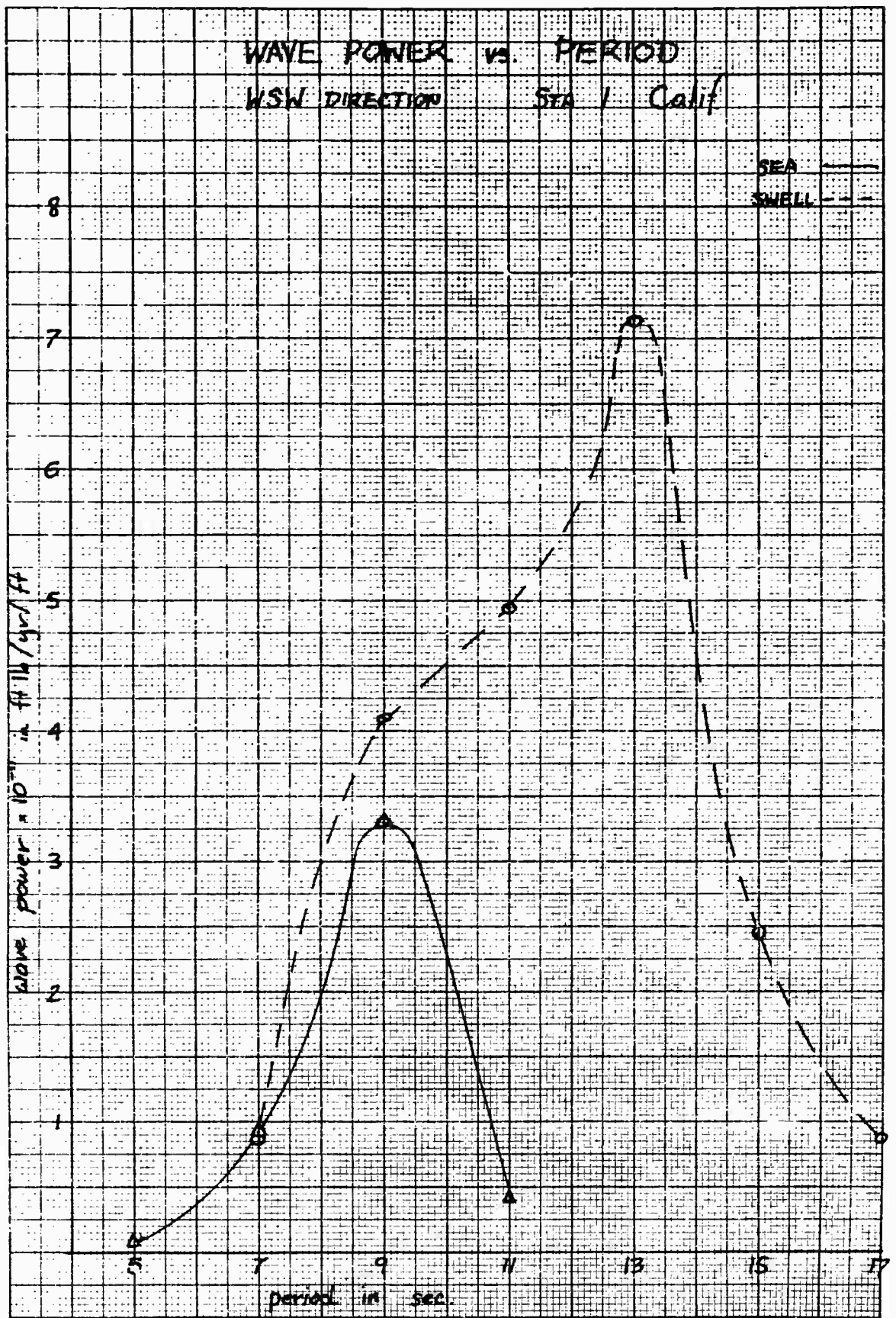
N direction Sta 1 Calif

SEA

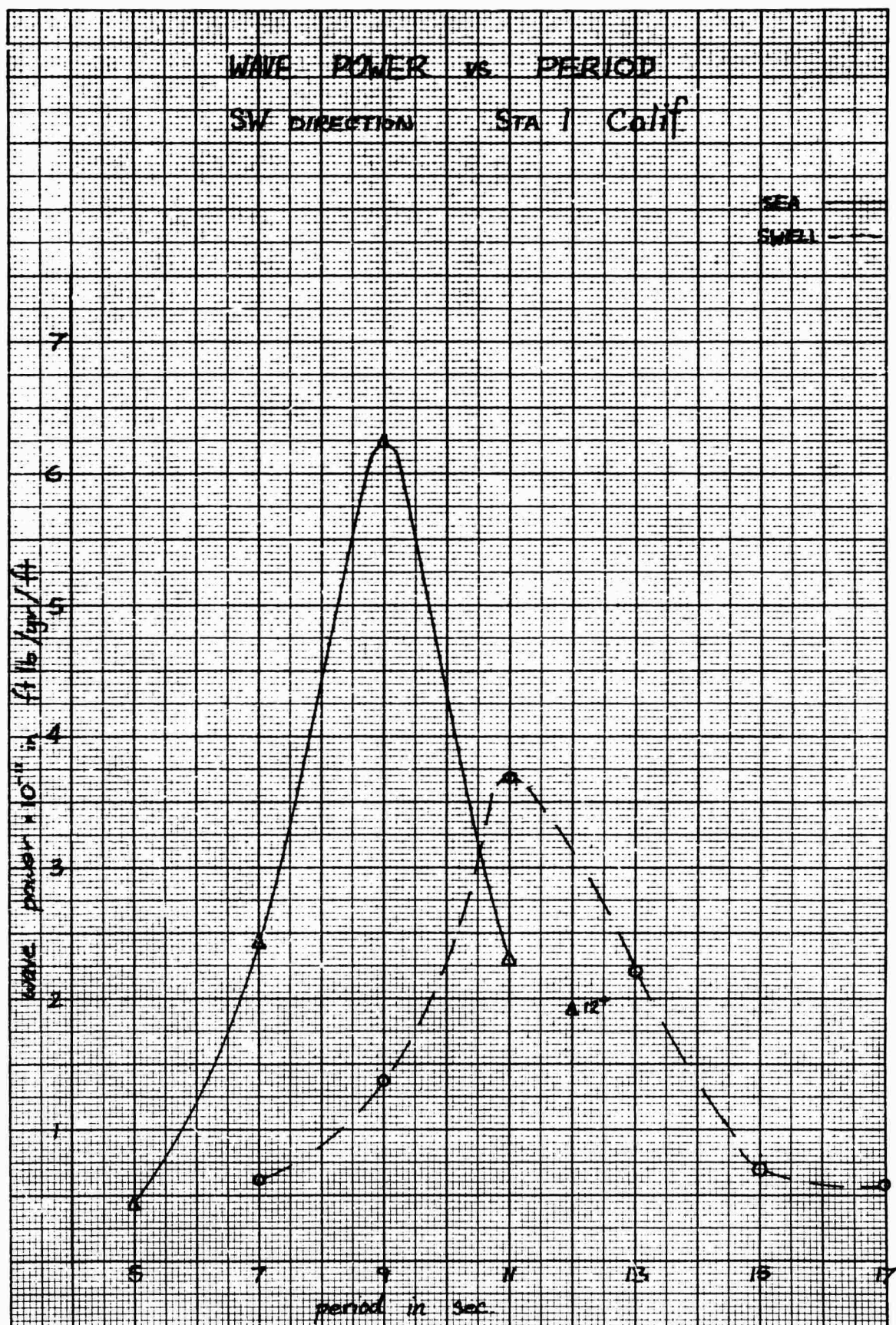
SWELL



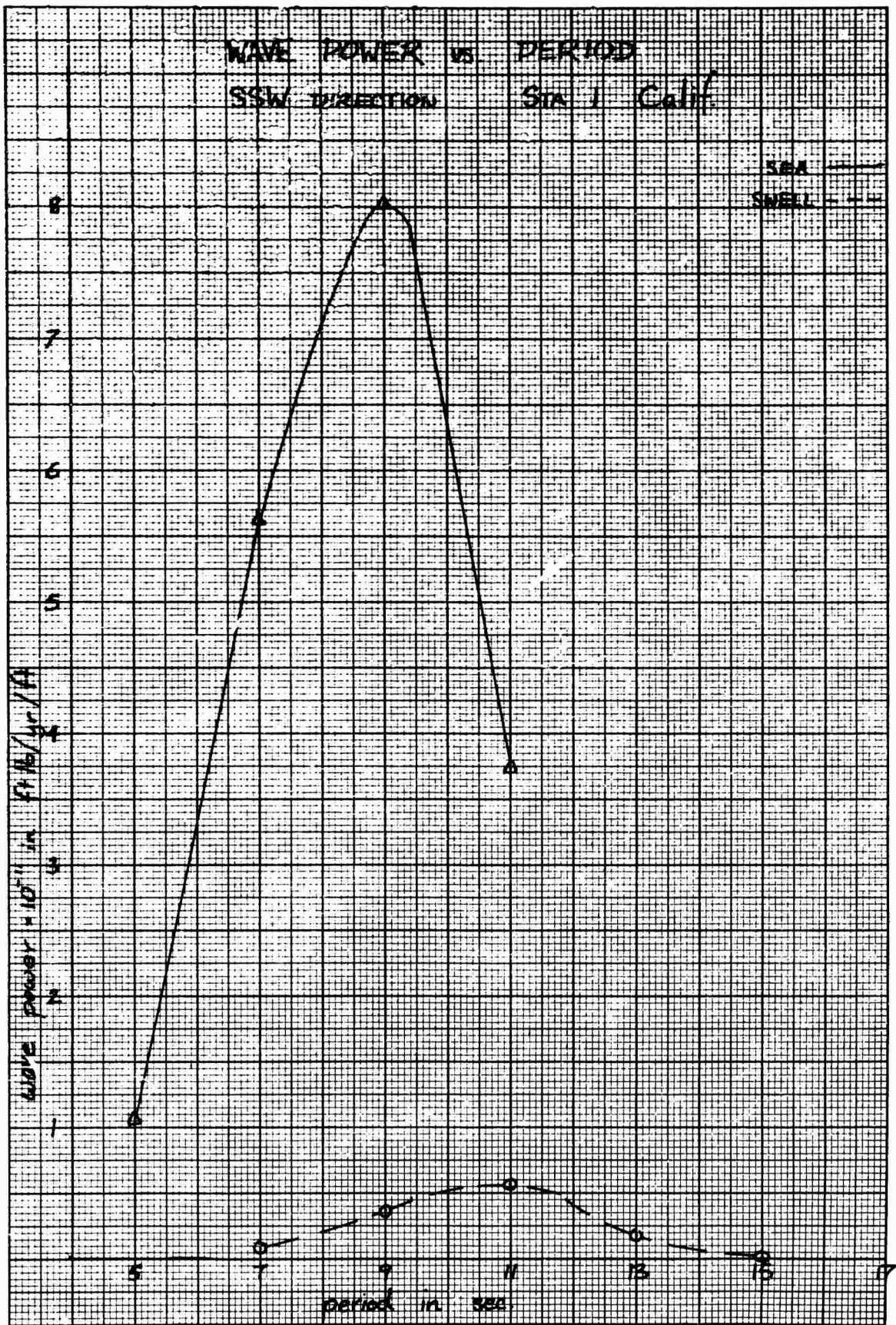
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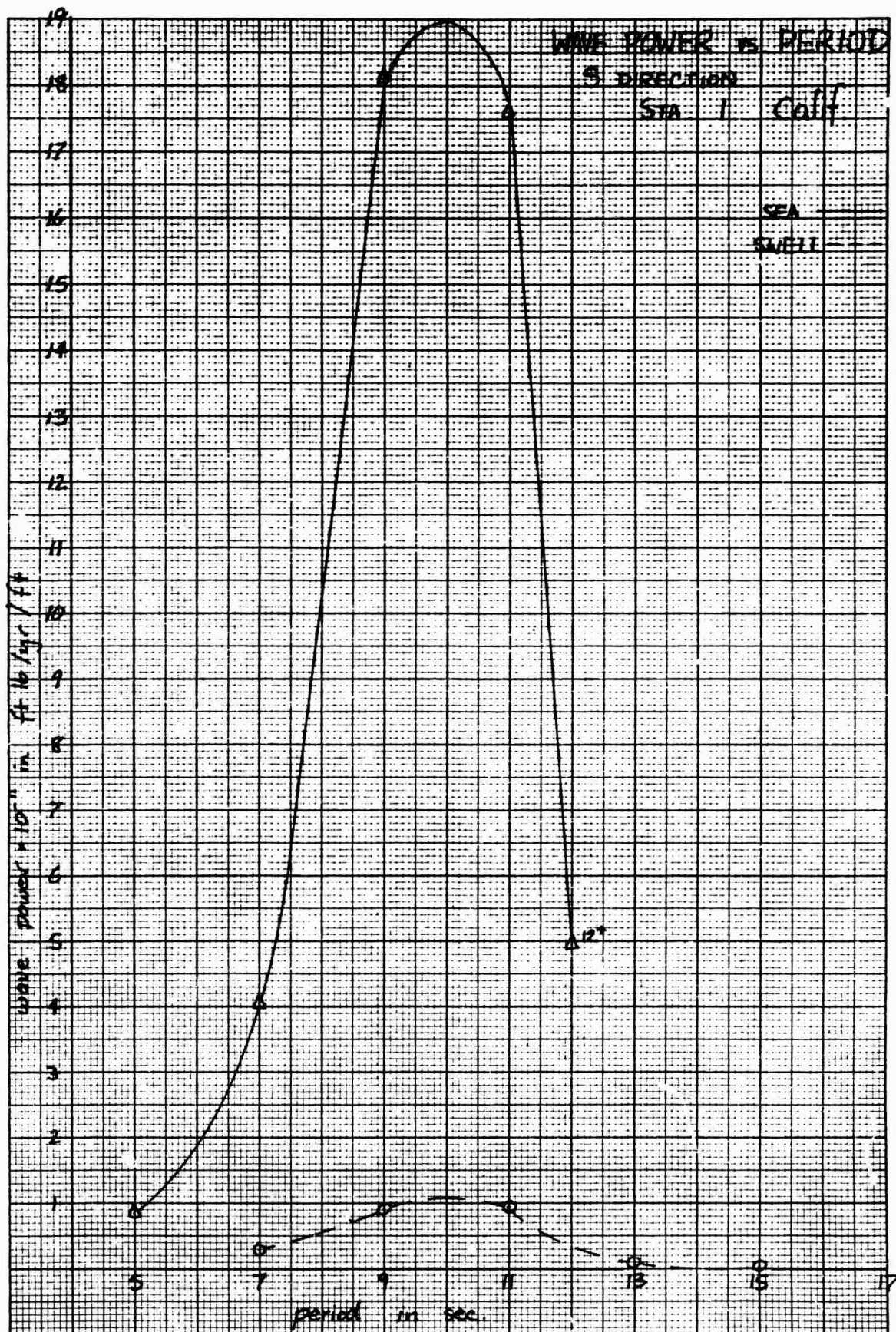
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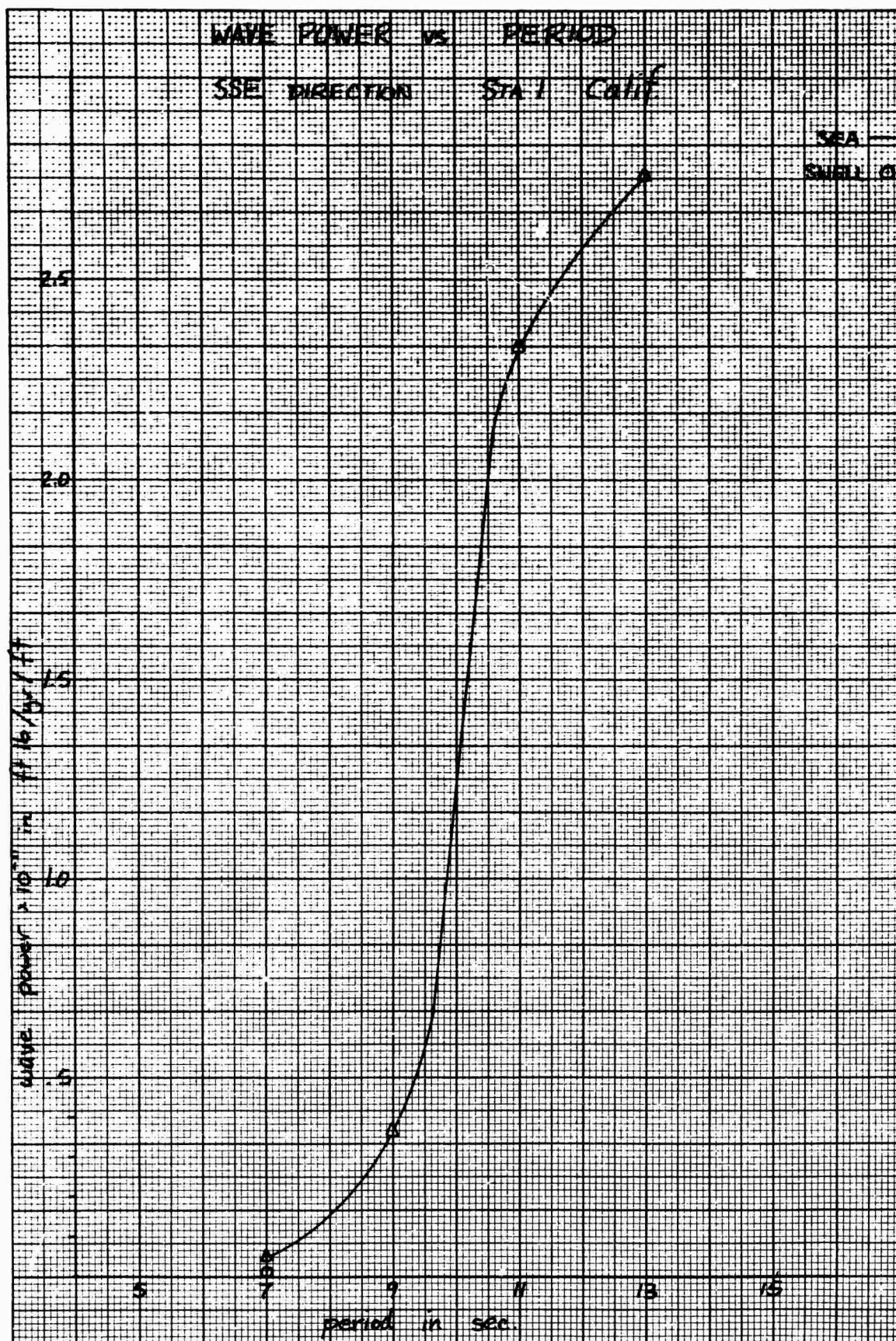
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KEUFFEL & ESSER CO.



K-E 10 X 10 TO 1/2 INCH 46 1323
7 1/4" X 10" INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

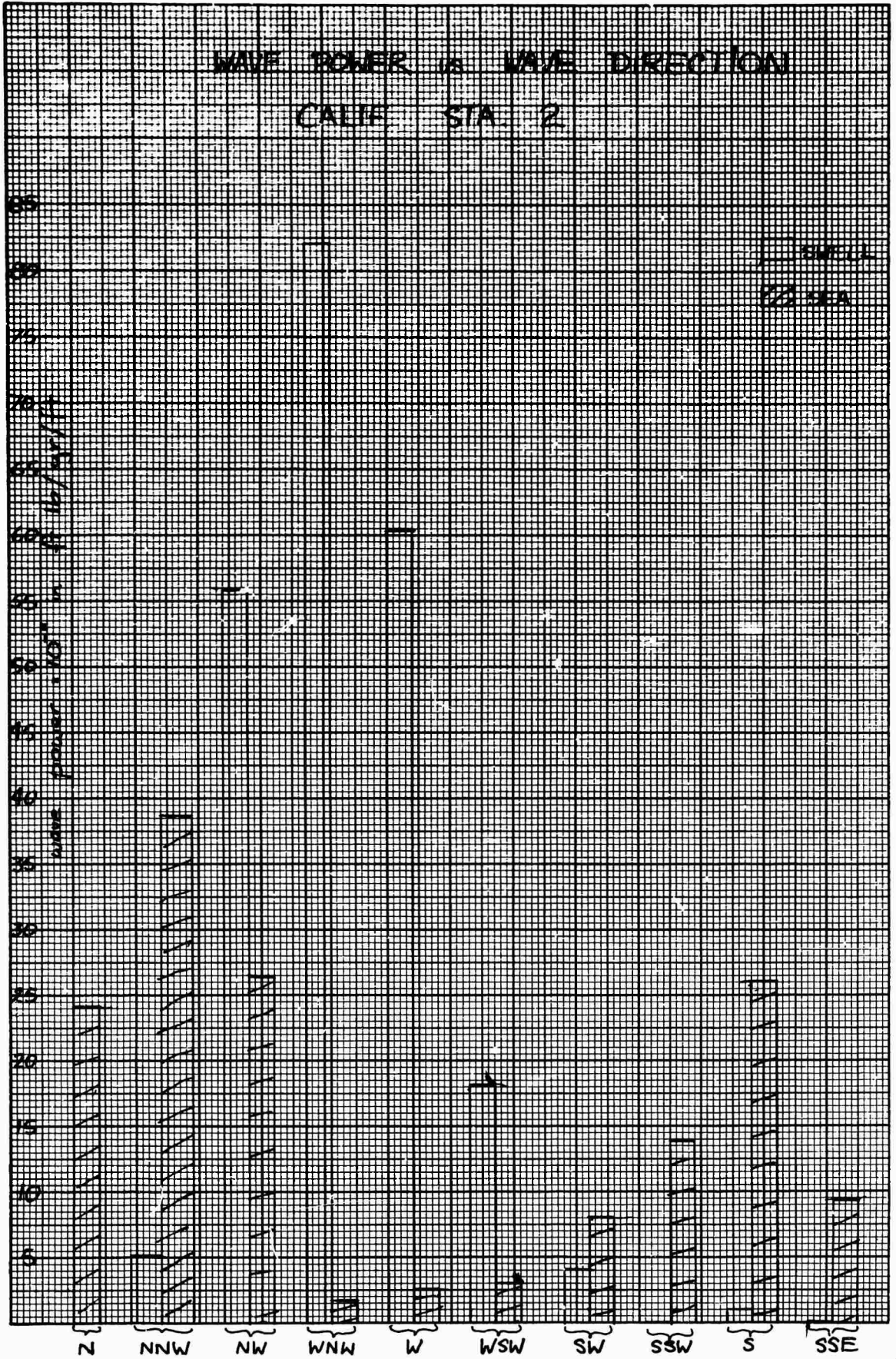


K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

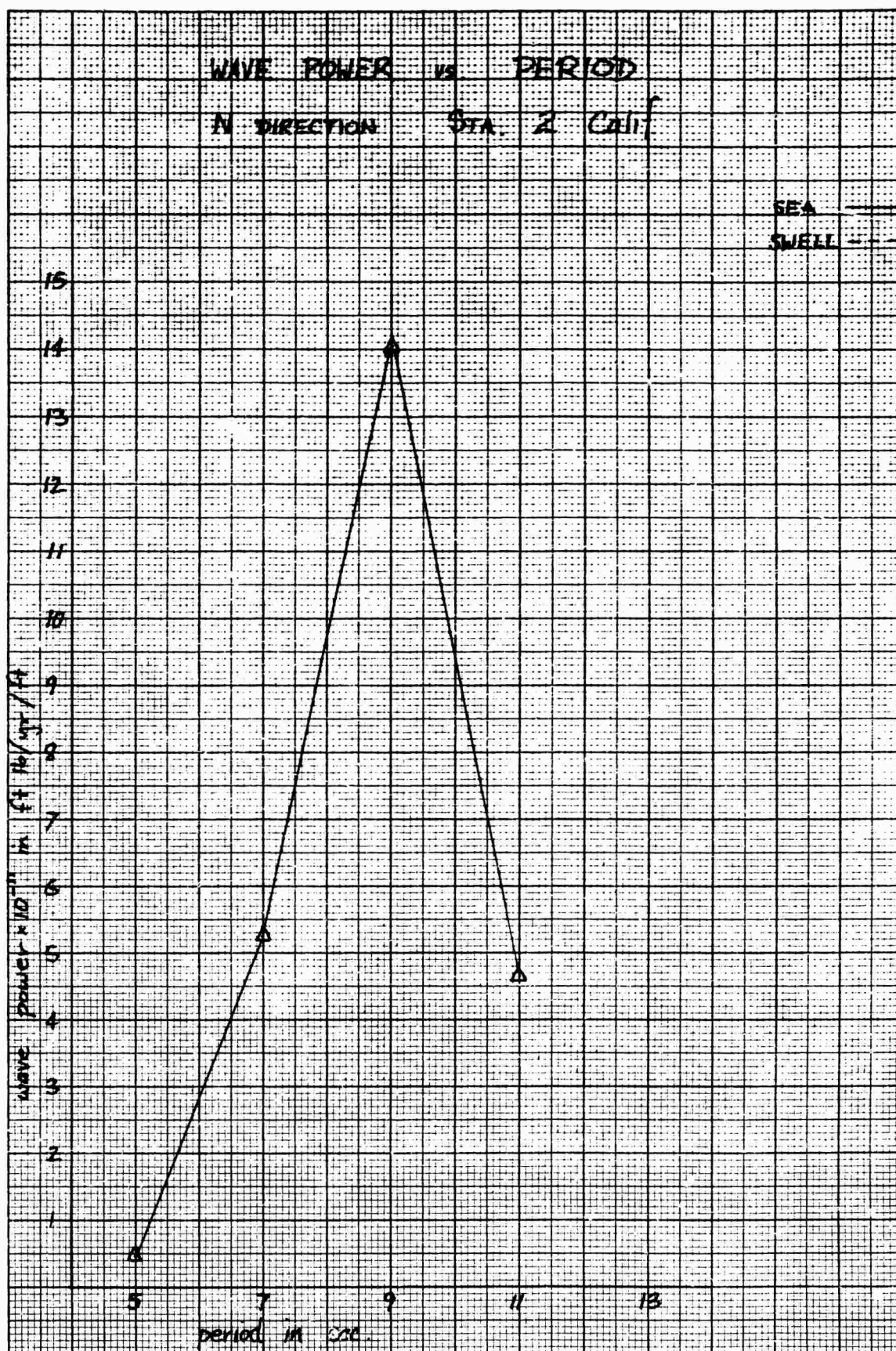


STATION 2 - CALIFORNIA COAST**Lat. 39.6°N , Long. 124.5°W**

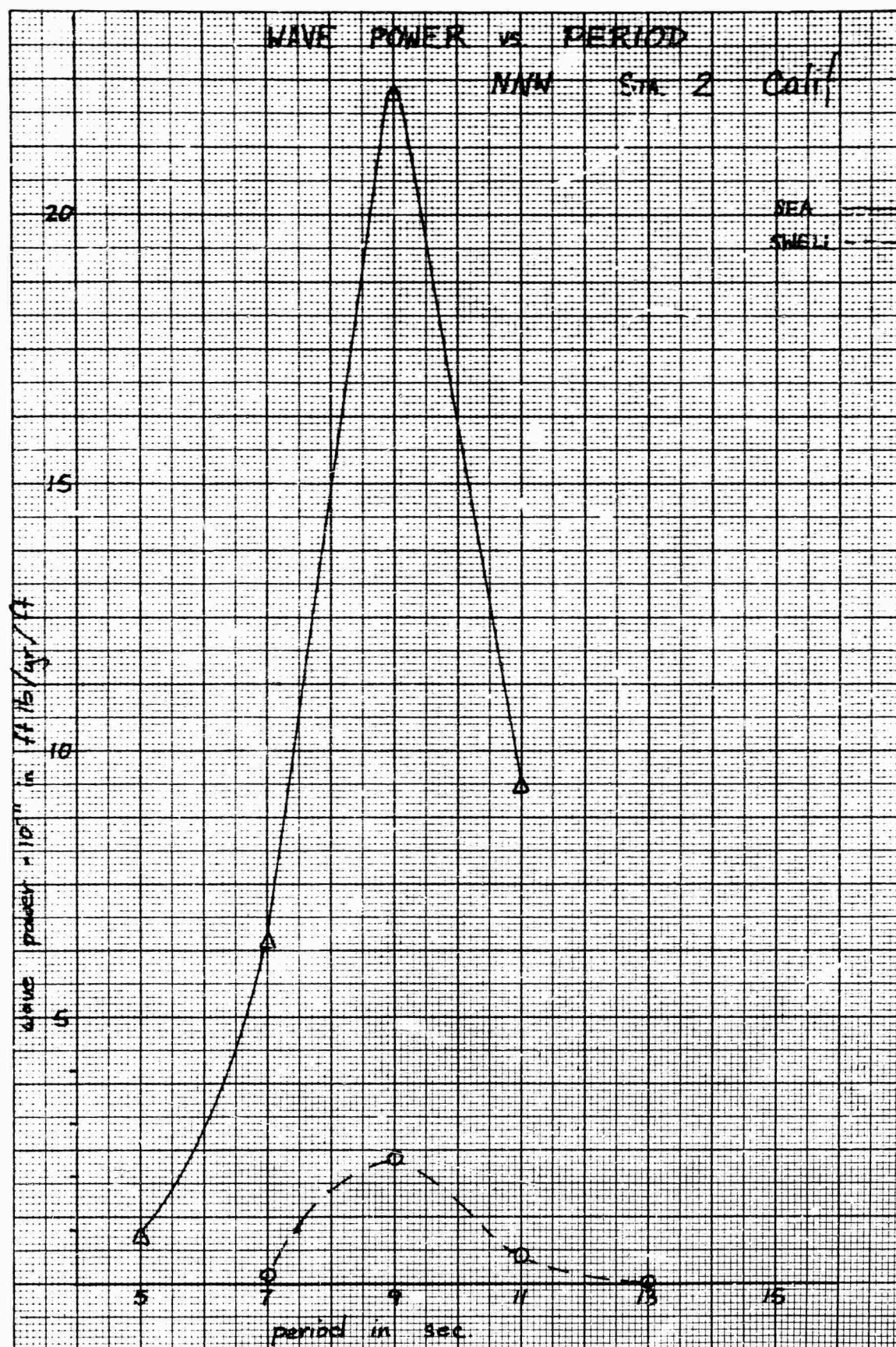
K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



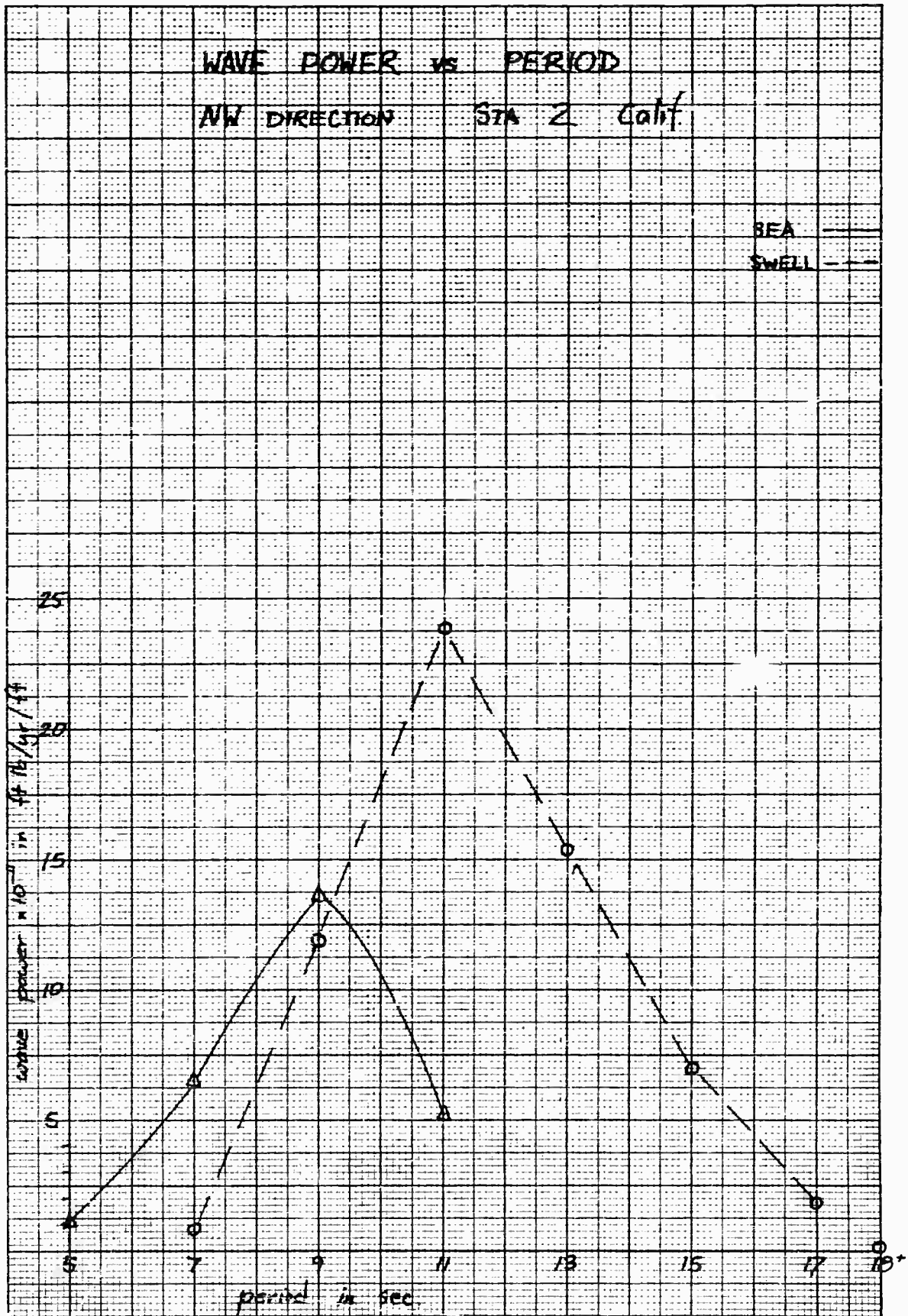
K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



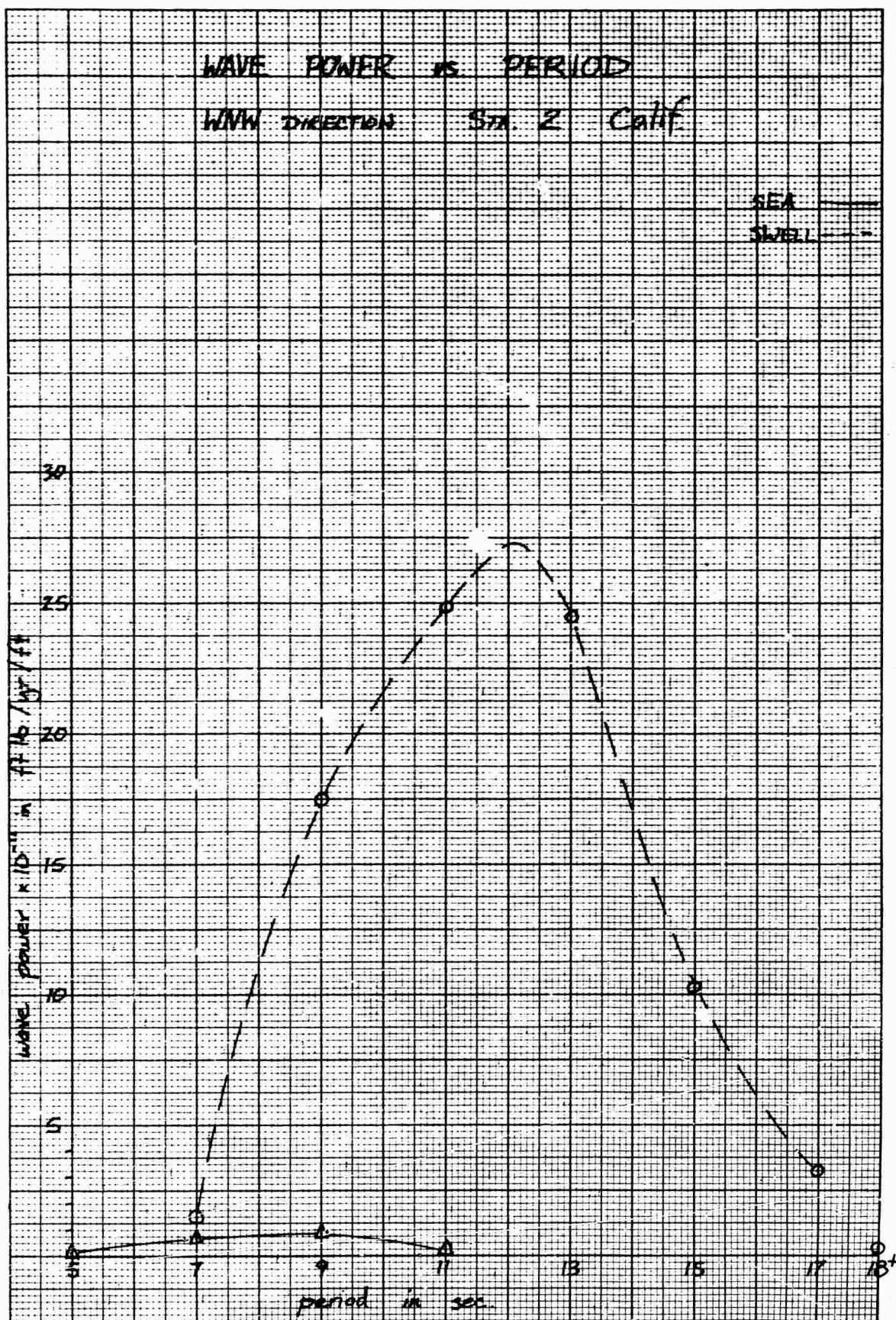
K-E 10 X 10 TO 1 1/2 INCH 46 1323
 1 X 10 INCHES
 HEUFFEL & LUBER CO.



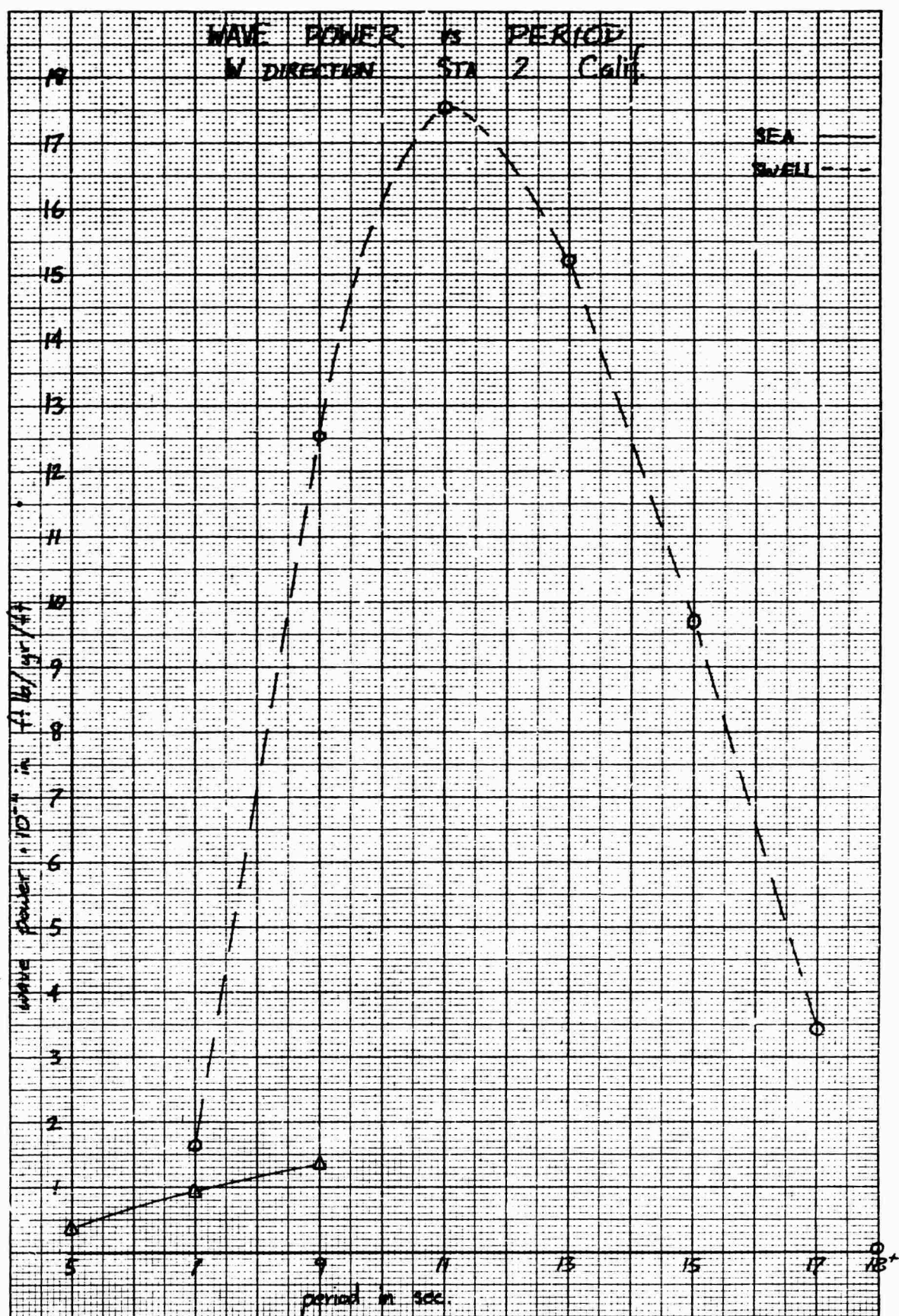
K&E 10 X 10 TO 1 1/2 INCH 46 1323
1 1/2 IN INCHES
NEUTREX & LAMAR CO.



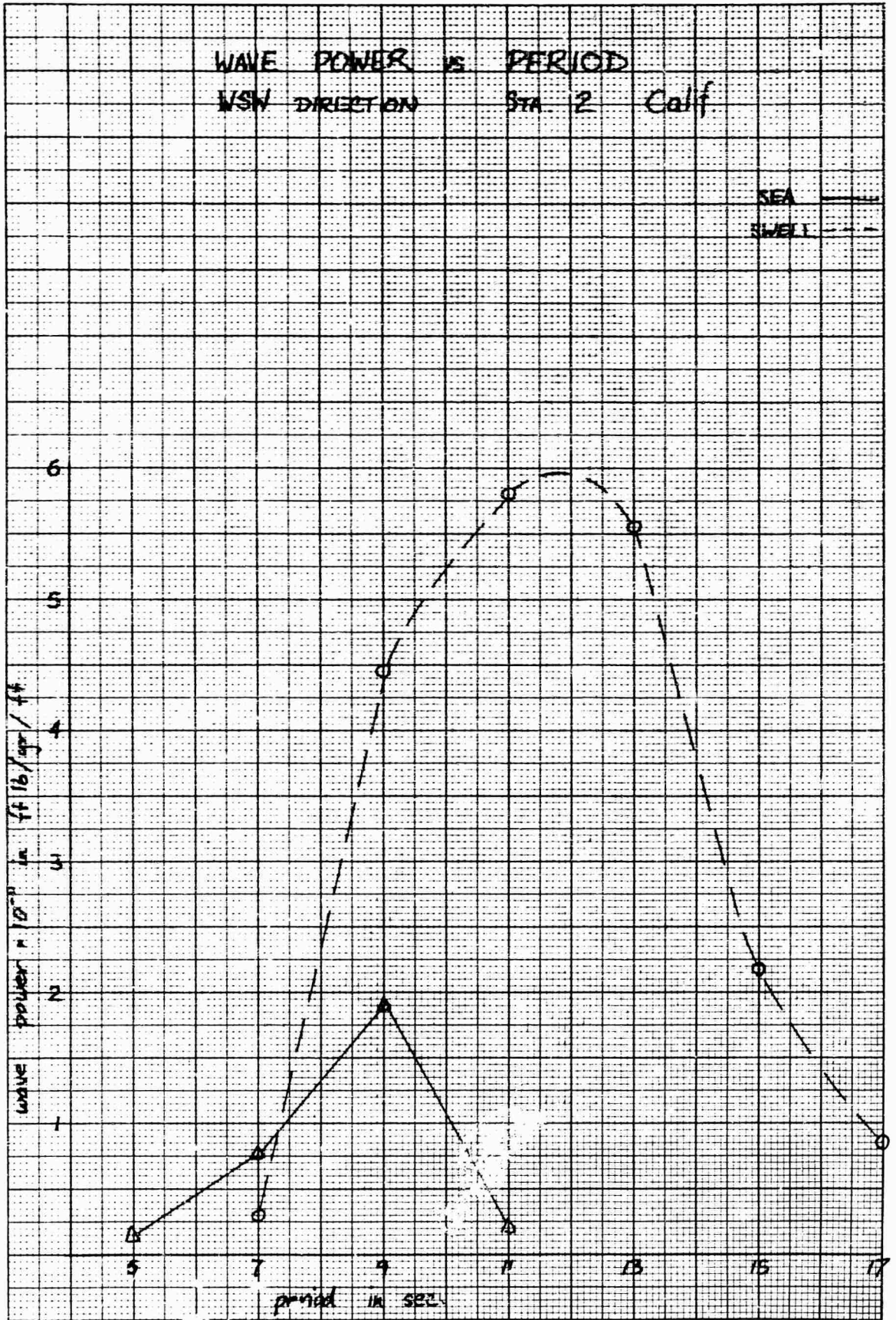
K-E 10 X 10 TO 15 INCH 48 1323
1 X 10 INCHES 304 IN U.S.A.
NEUFEL & EASER CO.

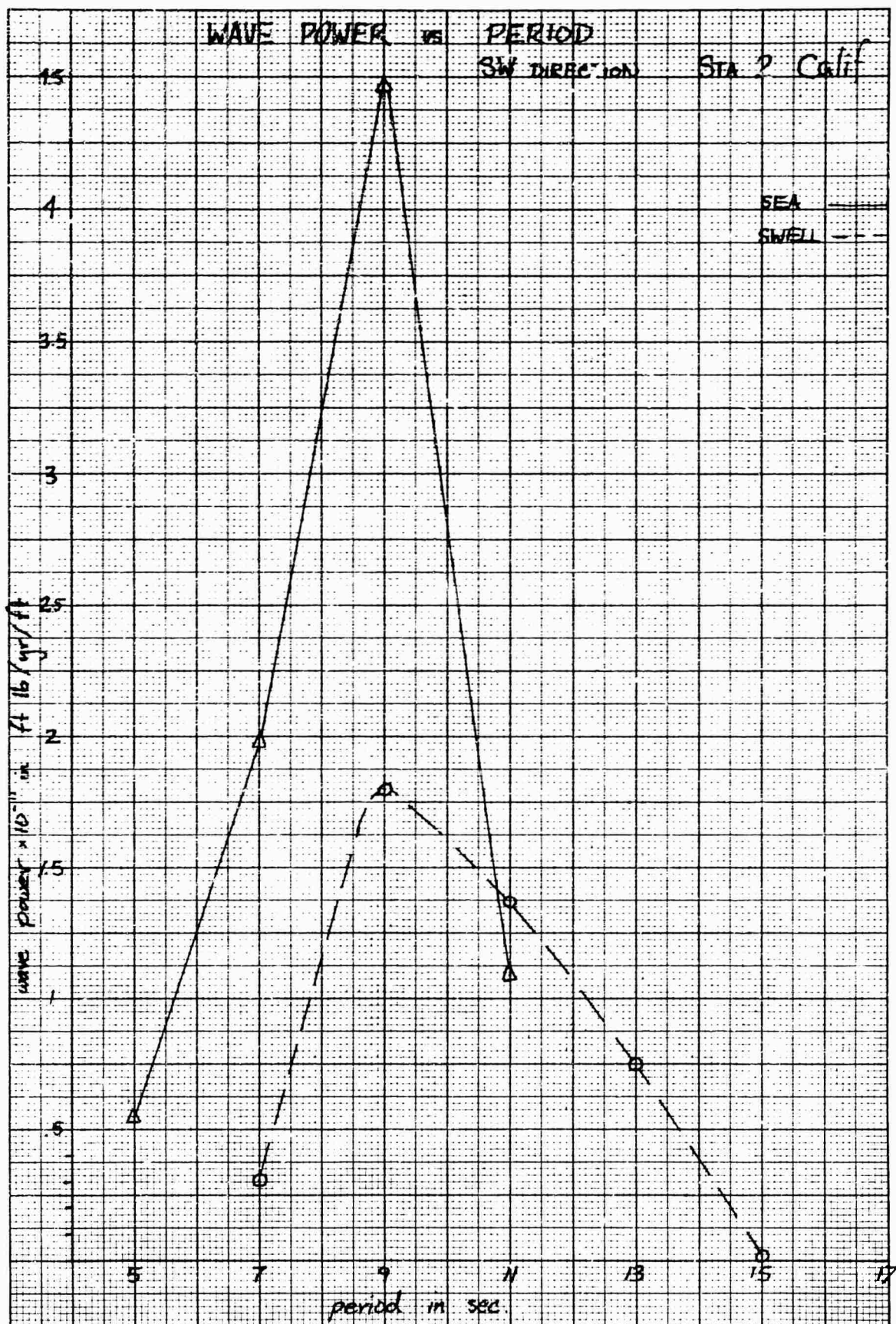


K-E 10 x 10 TO 1/2 INCH 46 1323
 7 x 10 INCHES MADE IN U.S.A.
 KEUFFEL & ESSER CO.

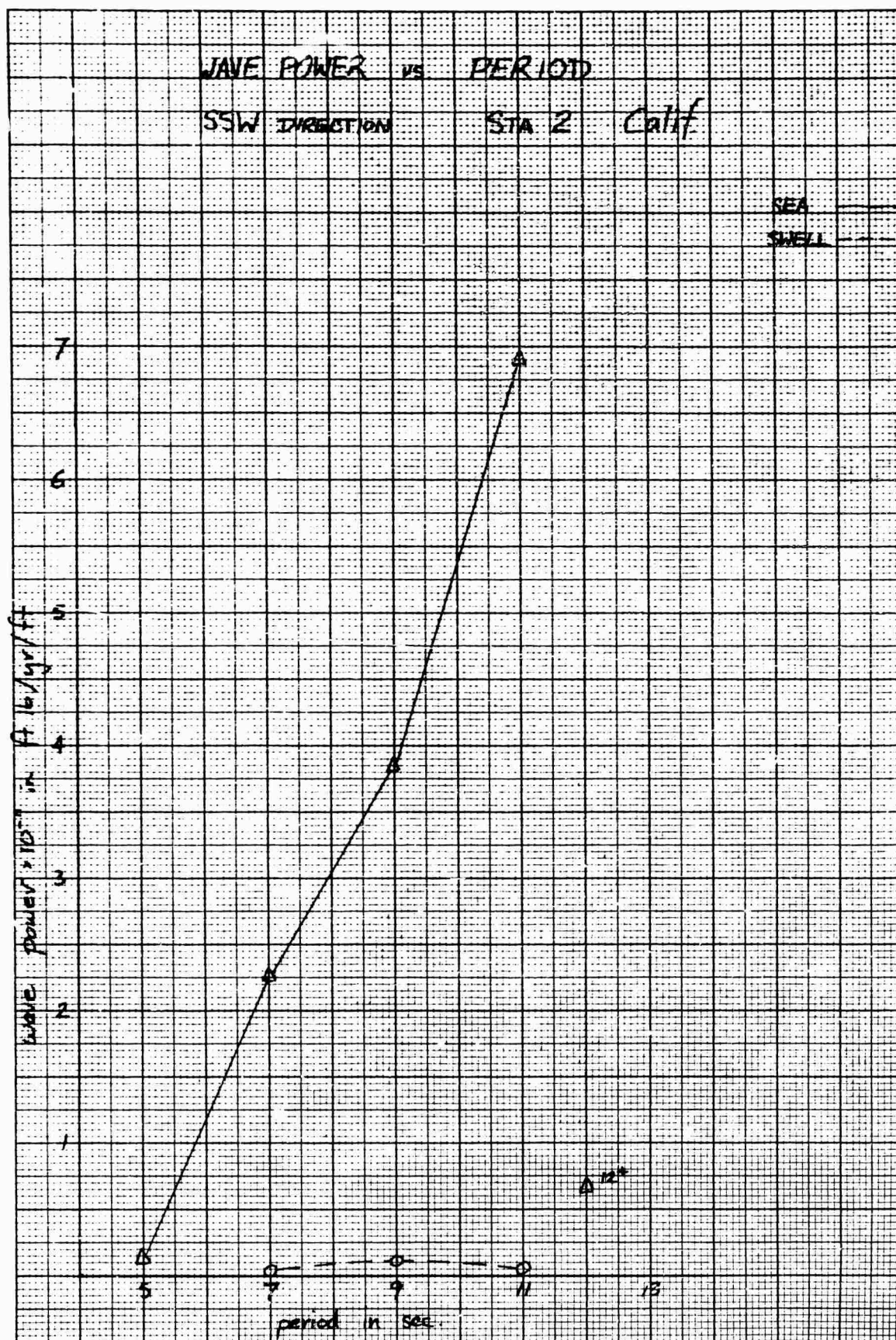


K&E
10 x 10 TO 1 1/2 INCH 46 1323
1 1/2 INCHES
KEUFFEL & ESSER CO.

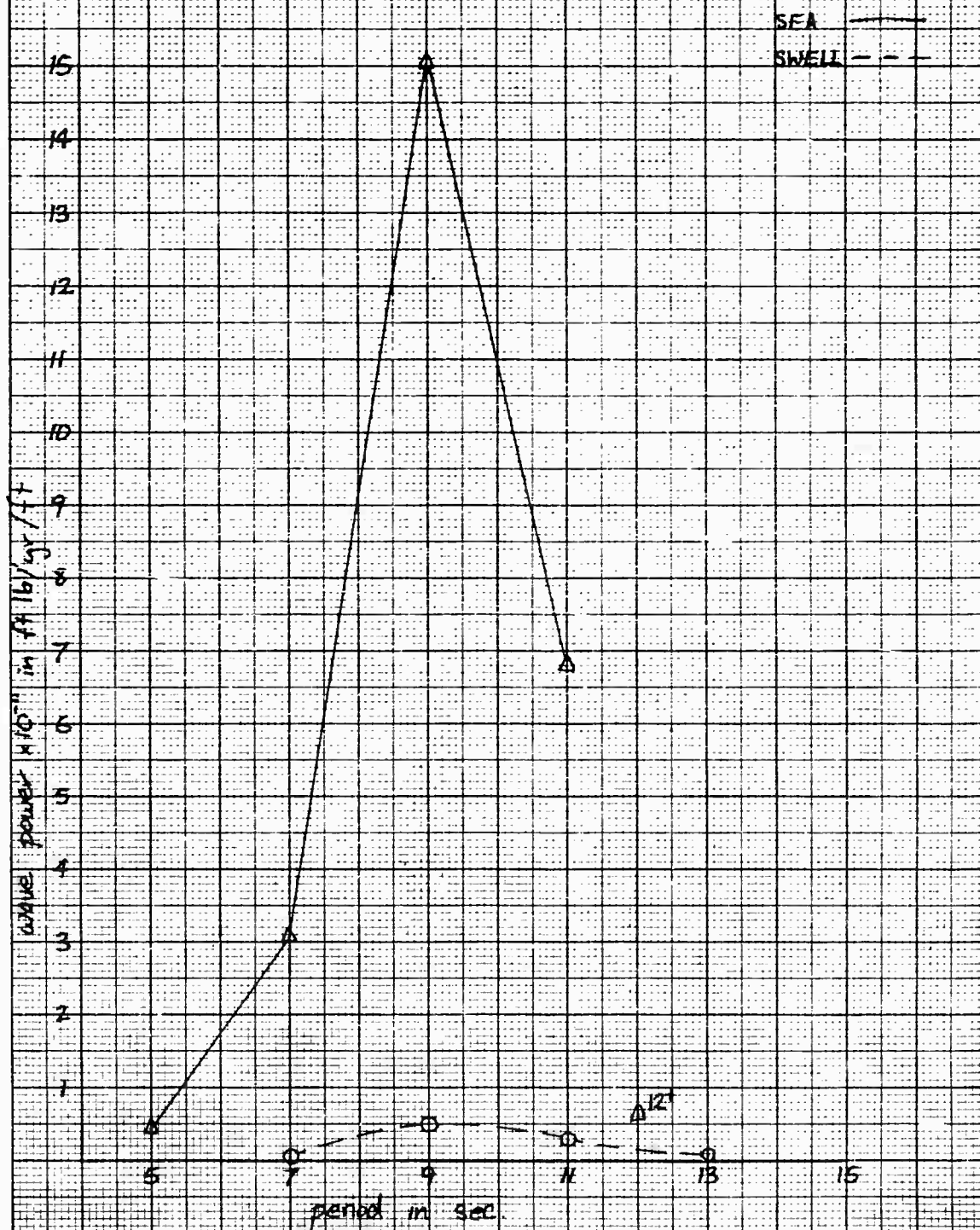




K&E 10 X 10 TO 1/2 INCH 46 1323
 7 X 10 INCHES 4611 U.S.A.
 KEUFFEL & ESSER CO.



WAVE POWER vs PERIOD S DIRECTION STA 2 Calif.

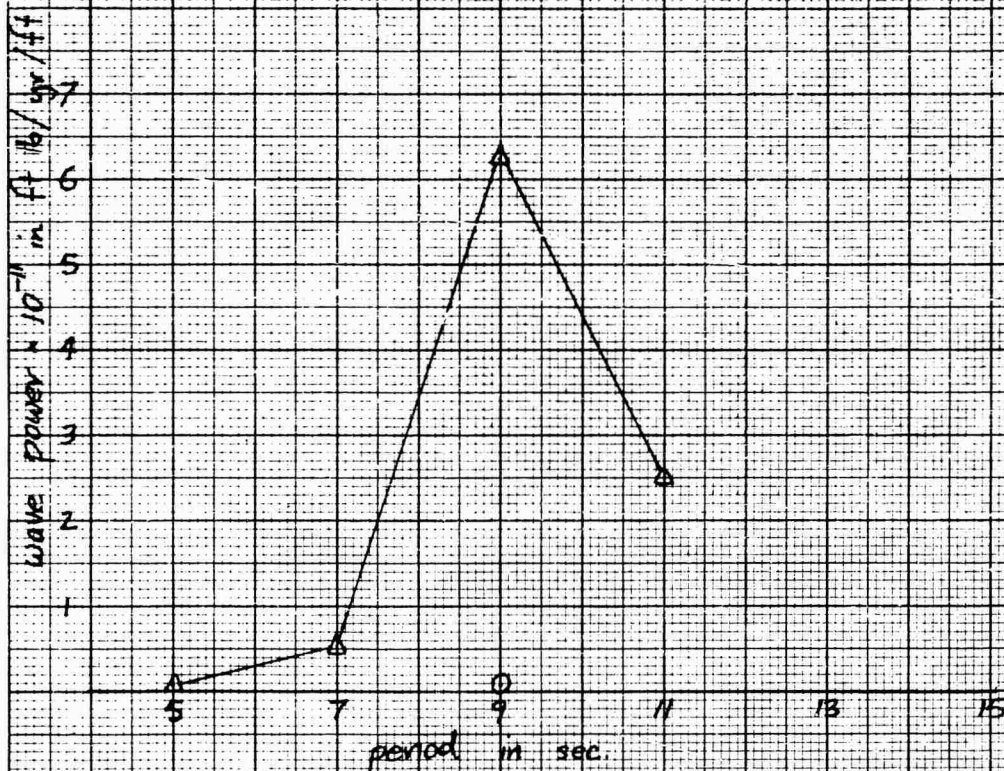


WAVE POWER VS PERIOD

SSE DIRECTION STA 2 Calif

SEA ———

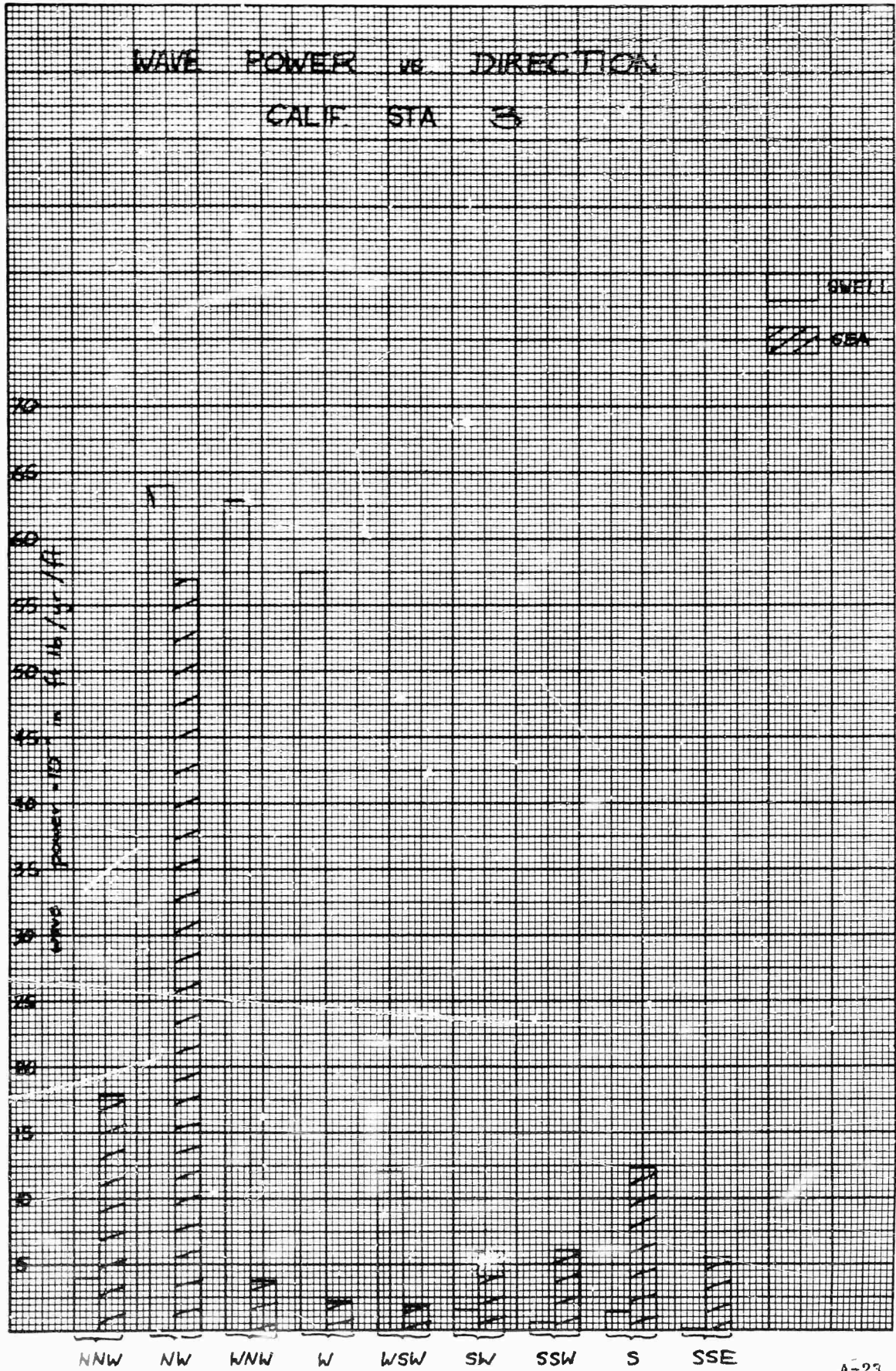
SWELL - - -

K&E
10 x 10 TO 1/2 INCH 40 1323
7 x 10 INCHES
KEUFFEL & ESSER CO.

STATION 3 - CALIFORNIA COAST

Lat. 37.6°N , Long. 123.5°W

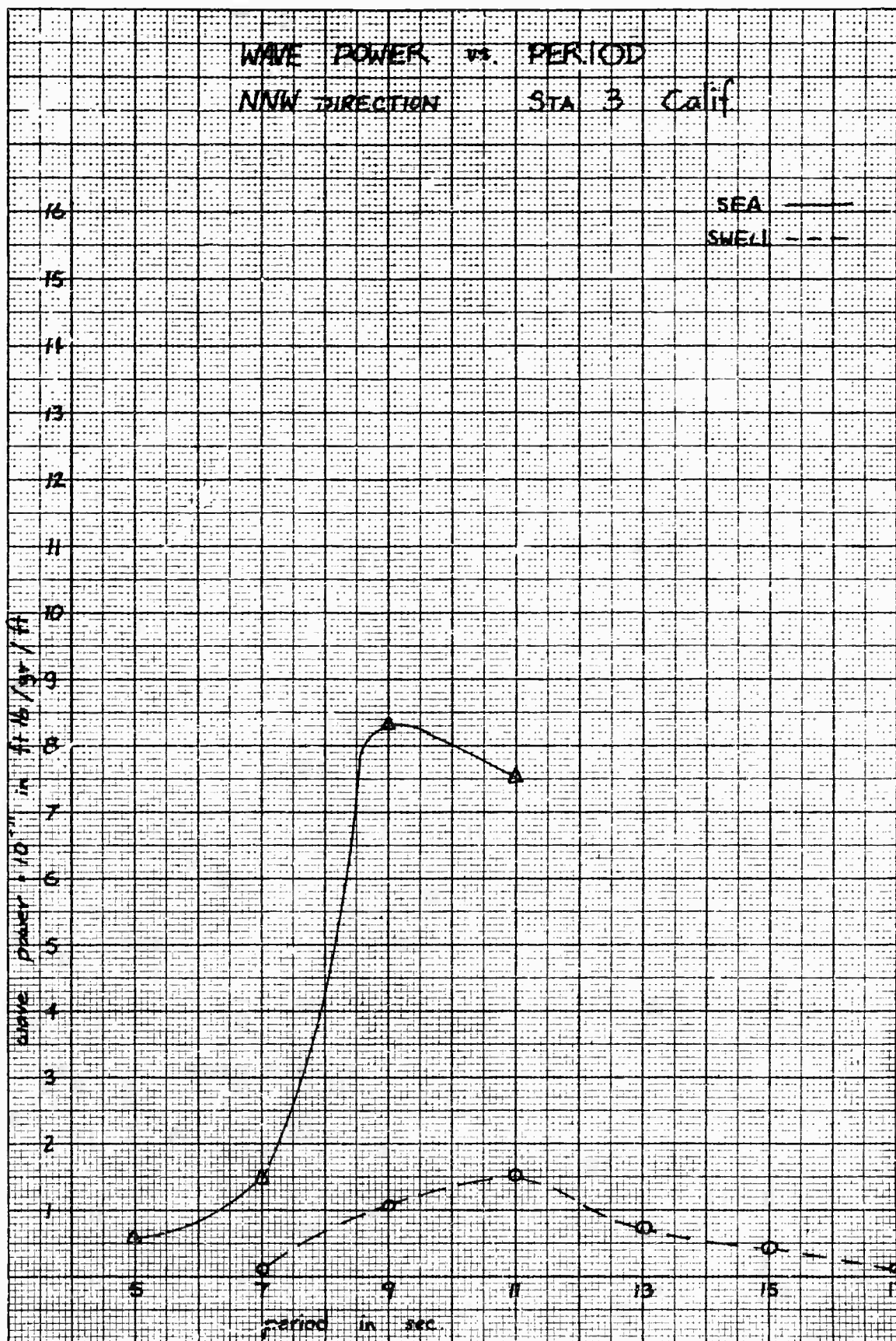
K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUPPEL & EBBEN CO.



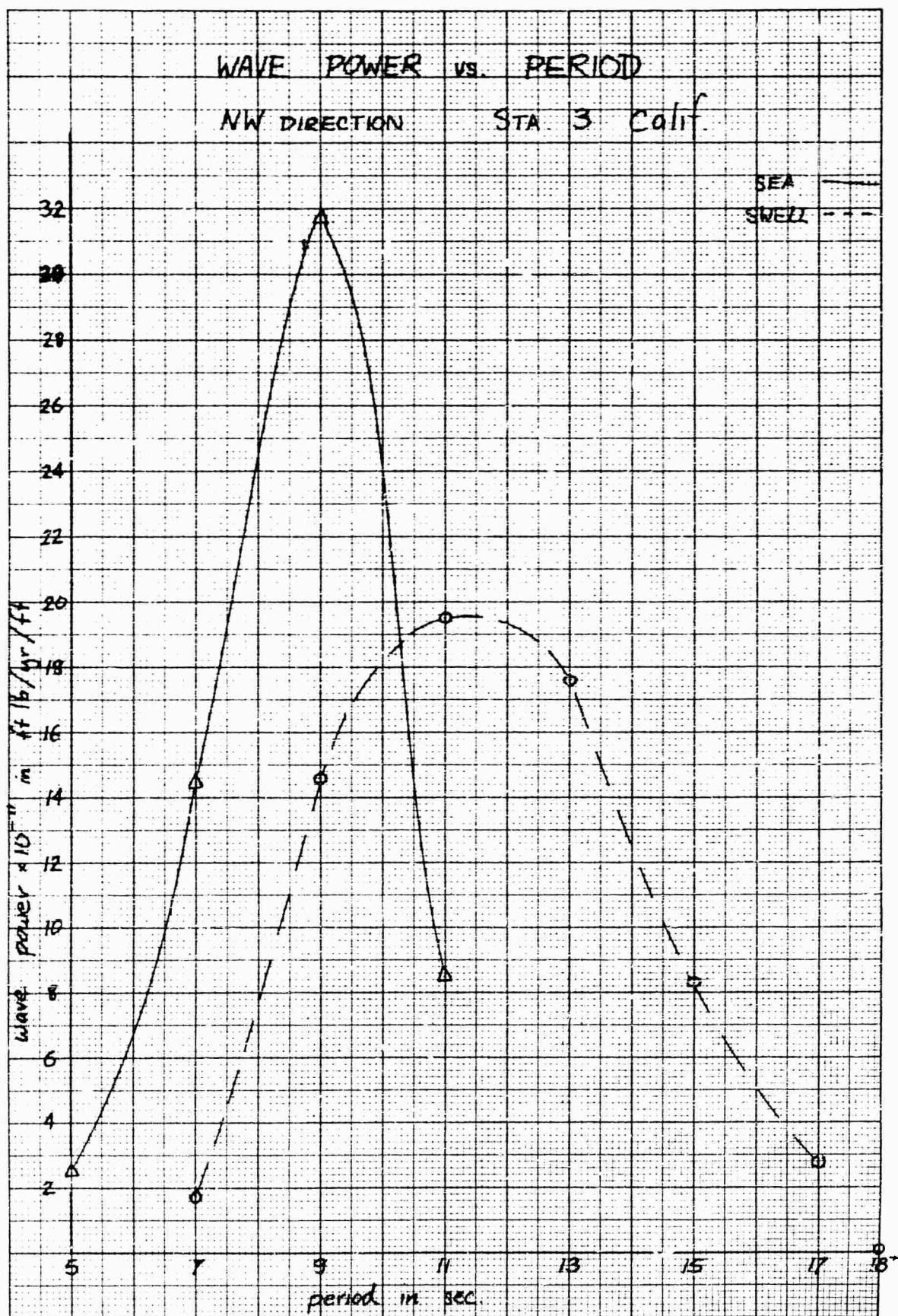
A-23

A-23

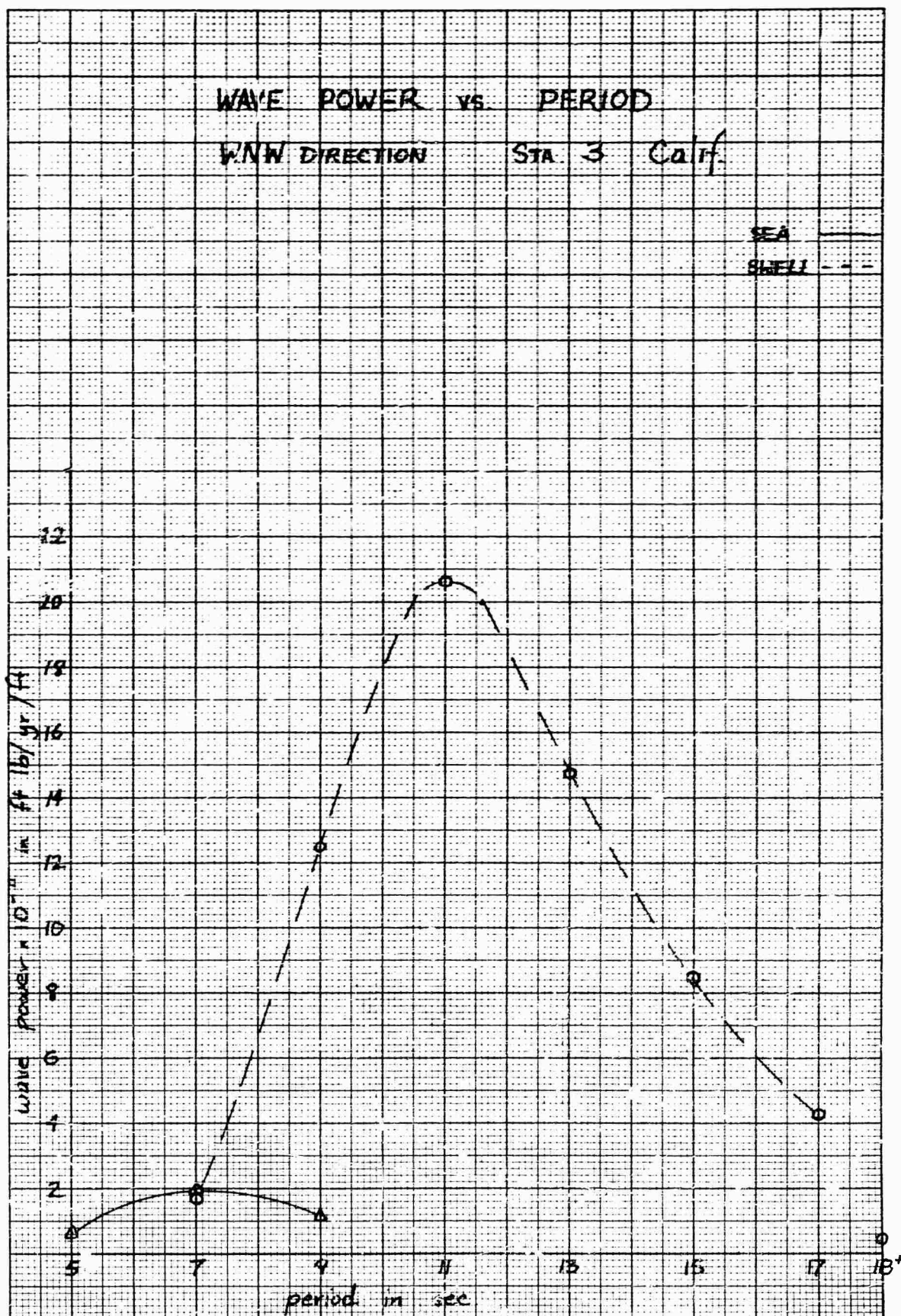
K&E 10 X 10 TO 1/2 INCH 46 1323
 7 X 10 INCHES
 KEUFFEL & ESTER CO.

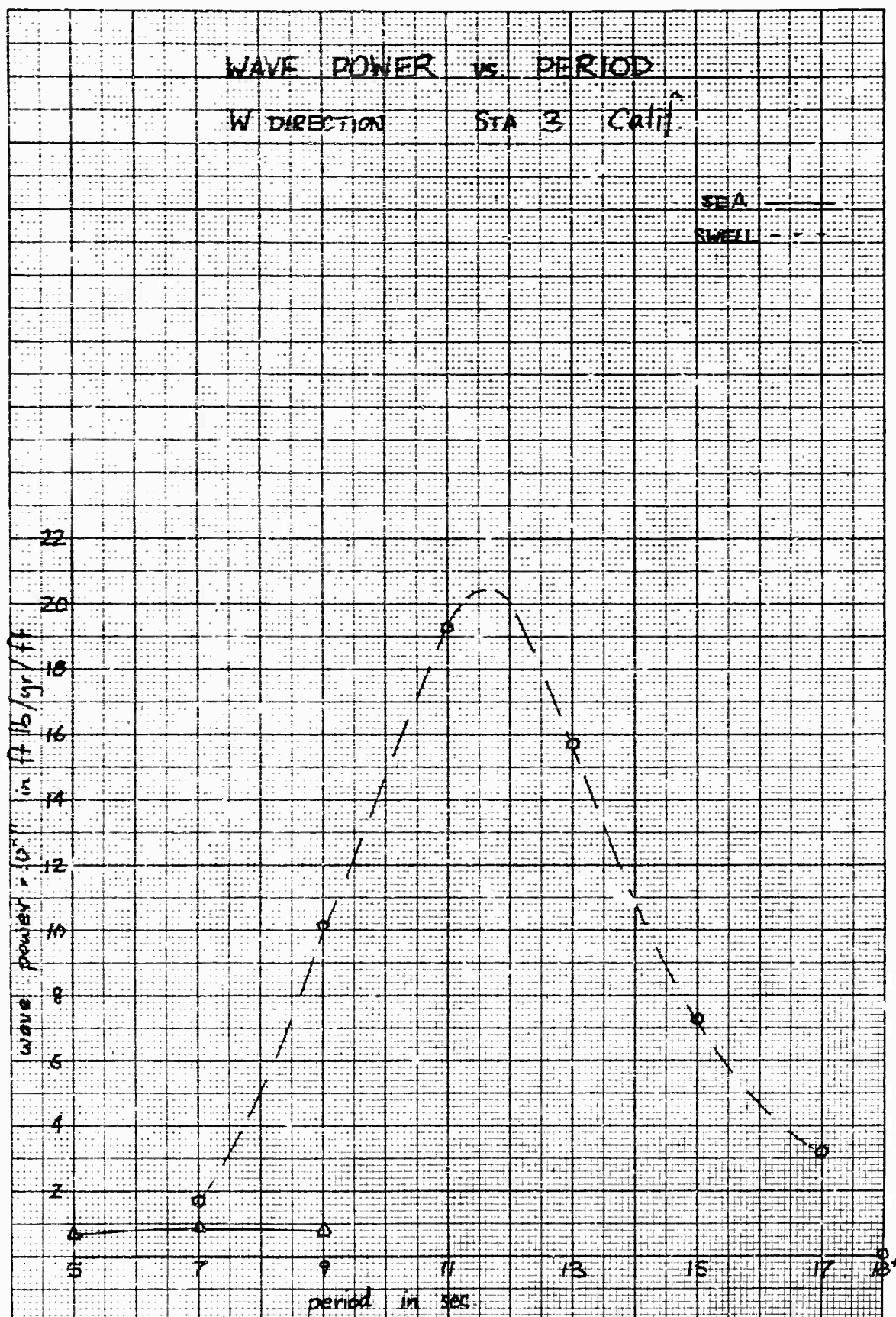


K-2 10 X 10 TO 17 INCH 46 1323
A-25

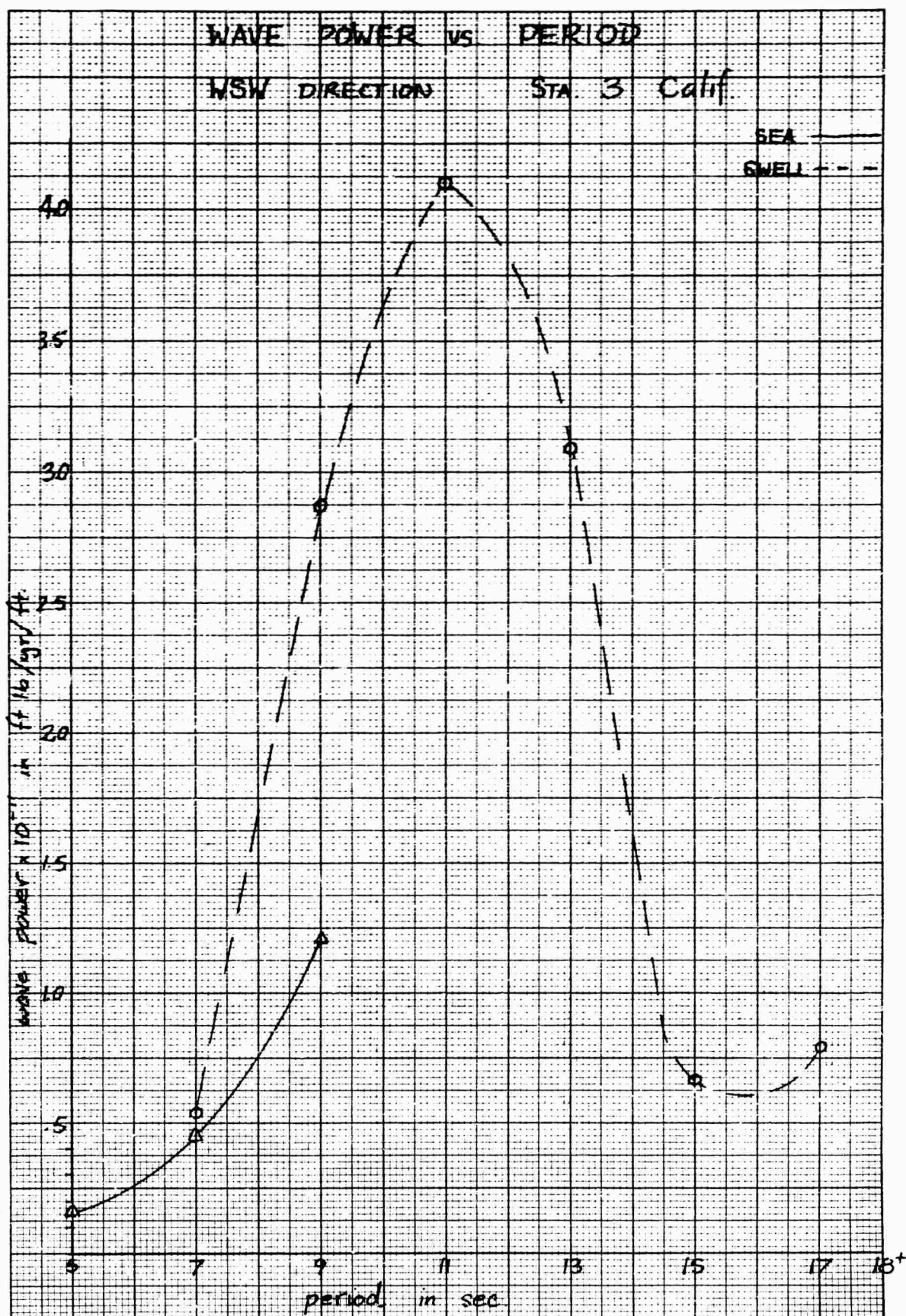


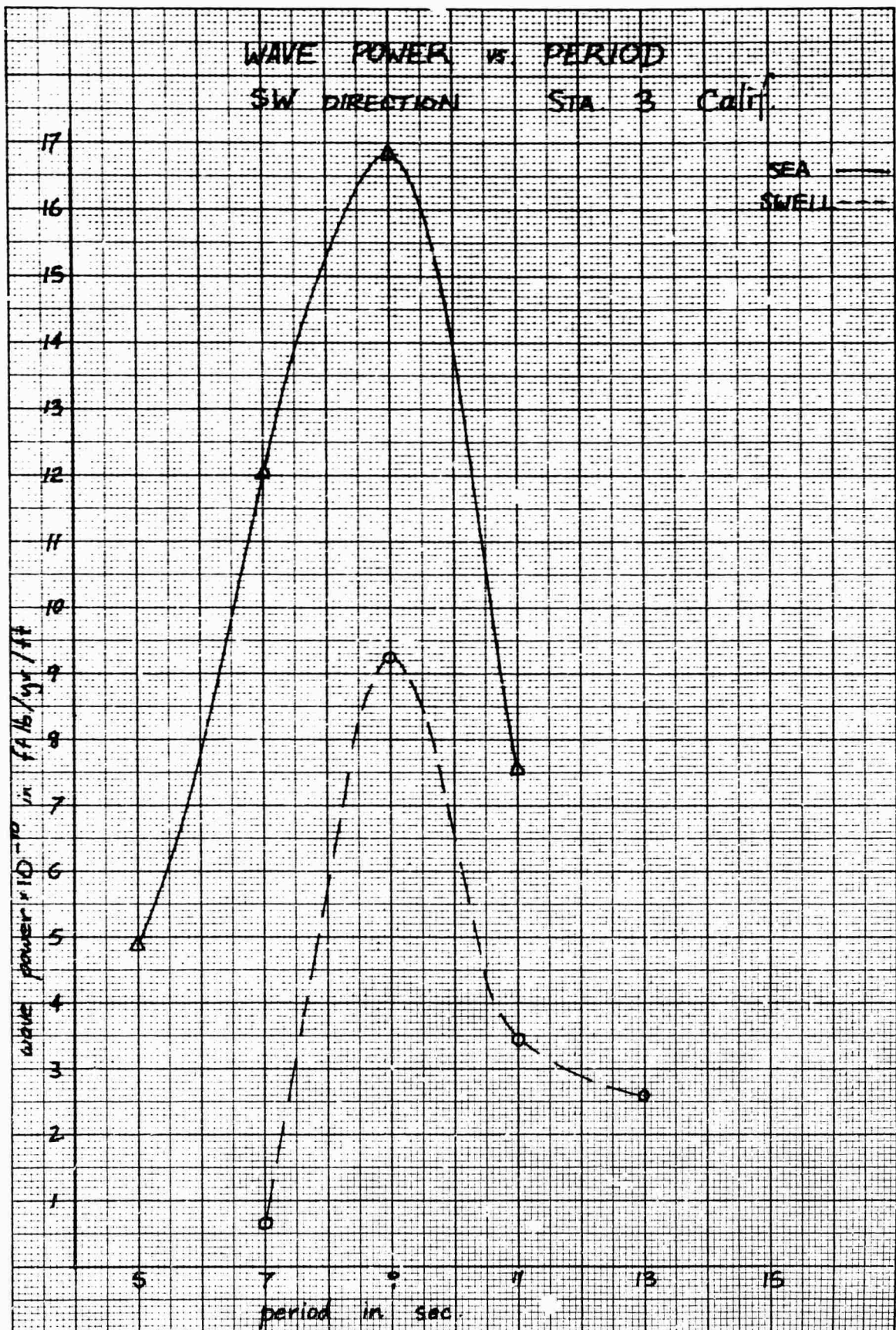
K&E 10 X 10 TO 1/2 INCH 46 1323
 1 X 10 INCHES MADE IN U.S.A.
 KNUFFEL & ESSER CO.





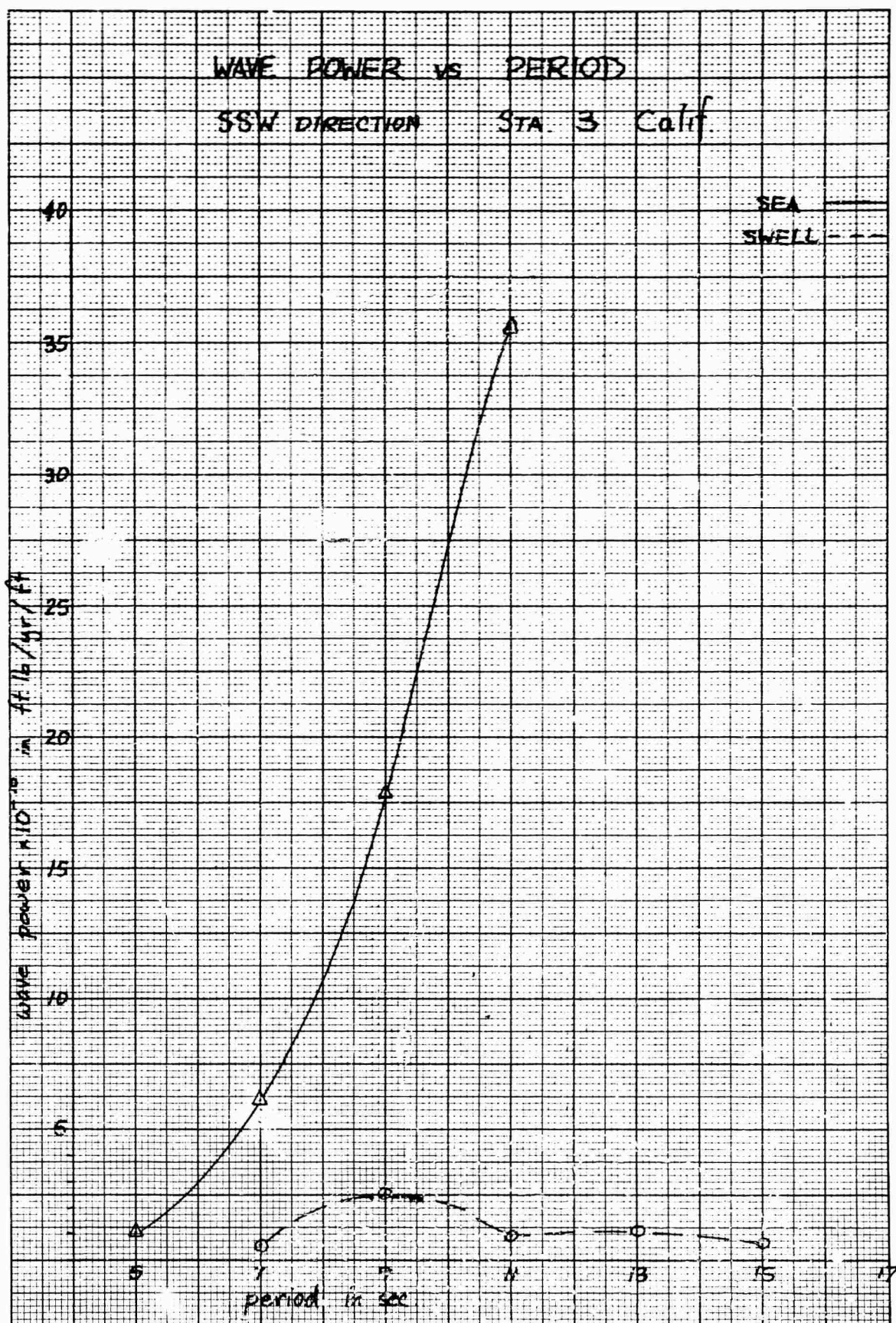
K&E 10 X 10 TO 1 1/2 INCH 46 1323
 7 1/2 X 10 INCHES
 KEUFFEL & ESSER CO.



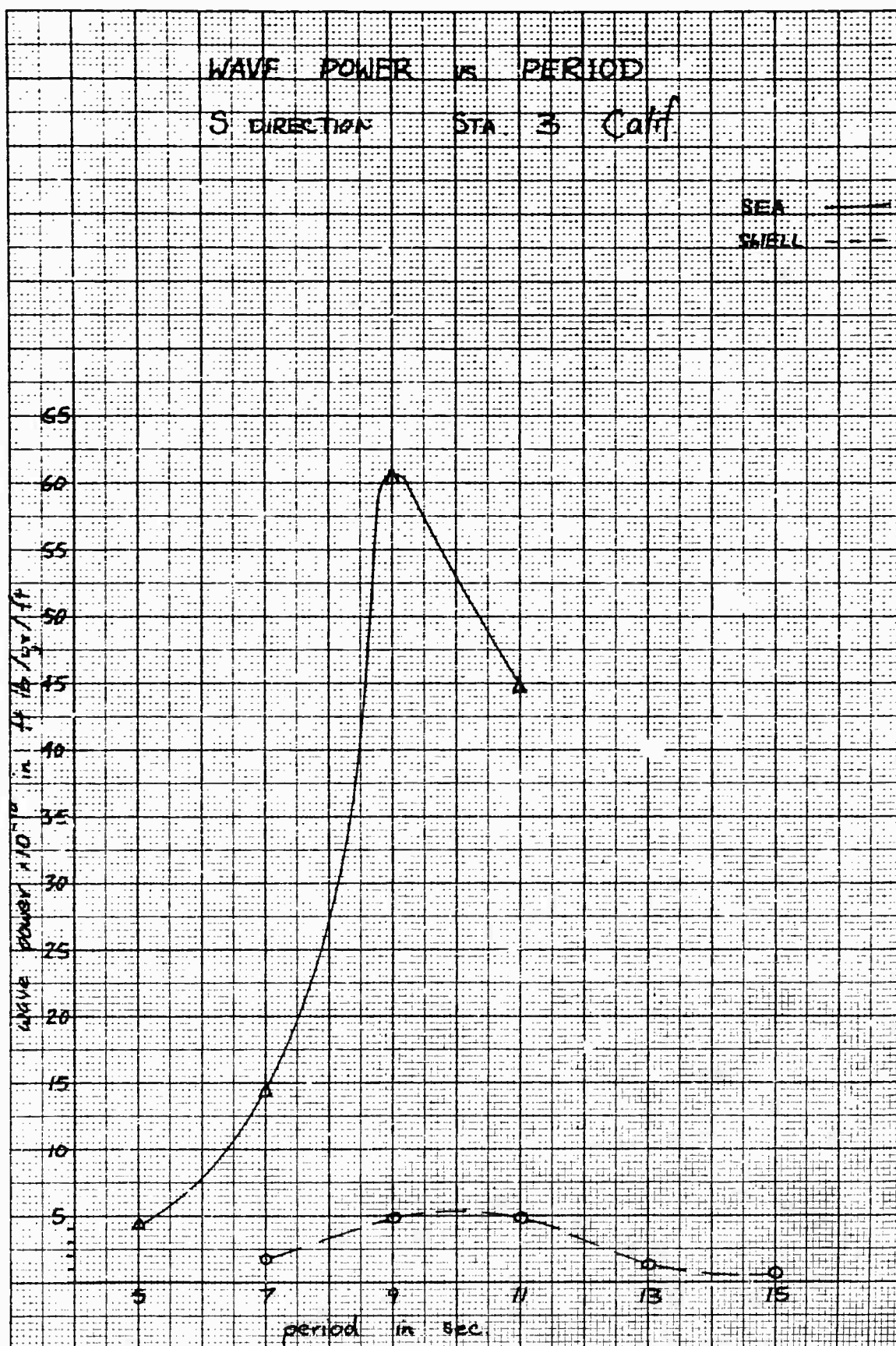


K&E 10 X 10 TO 1/2 INCH 461323
MADE IN U.S.A.
KLUFFEL & LASSER CO.

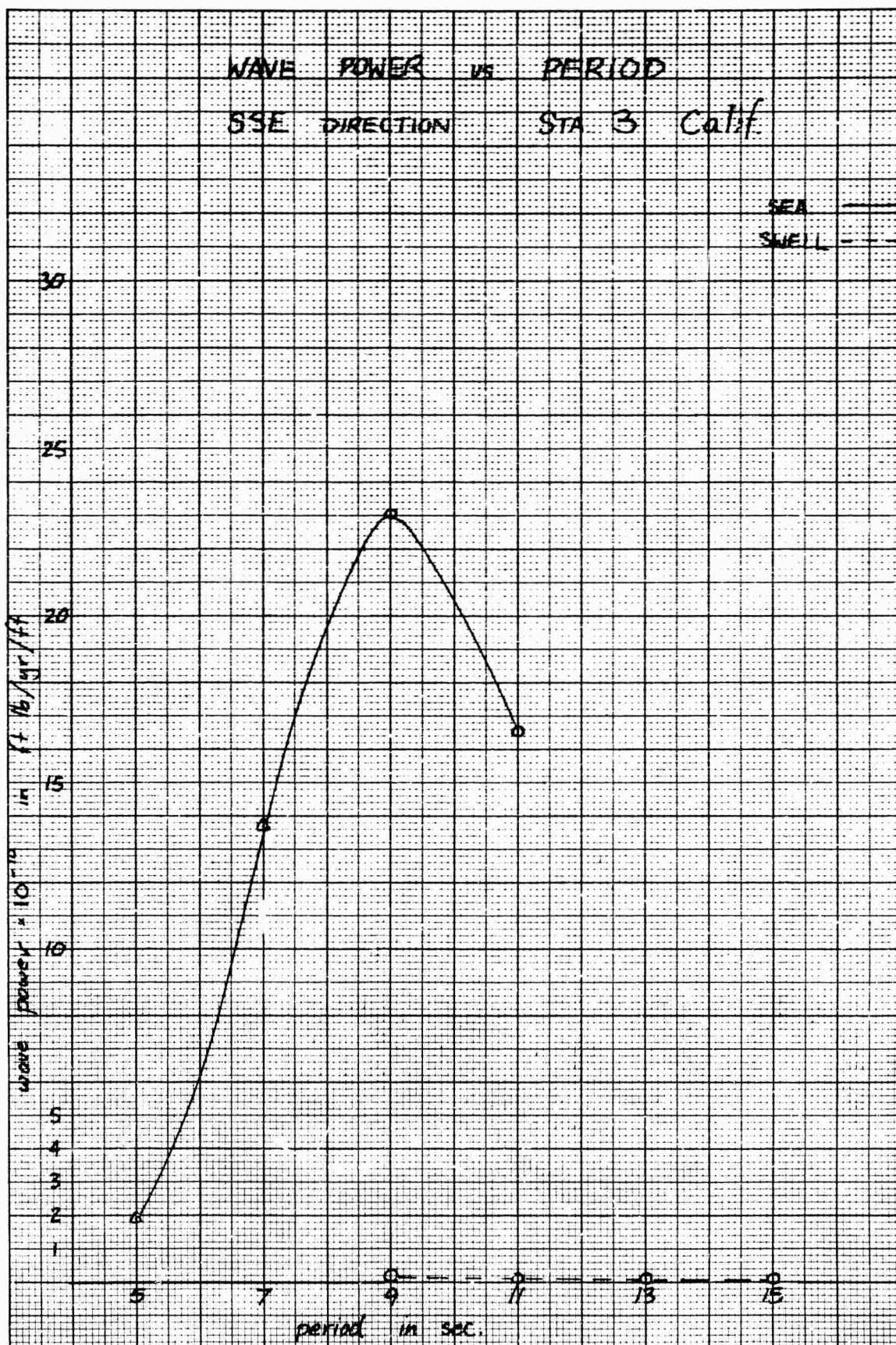
K&E 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



K&E 10 X 10 TO 1/2 INCH 46 1323
 2 X 10 INCHES MADE IN U.S.A.
 KEUFFEL & ESSER CO.



K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

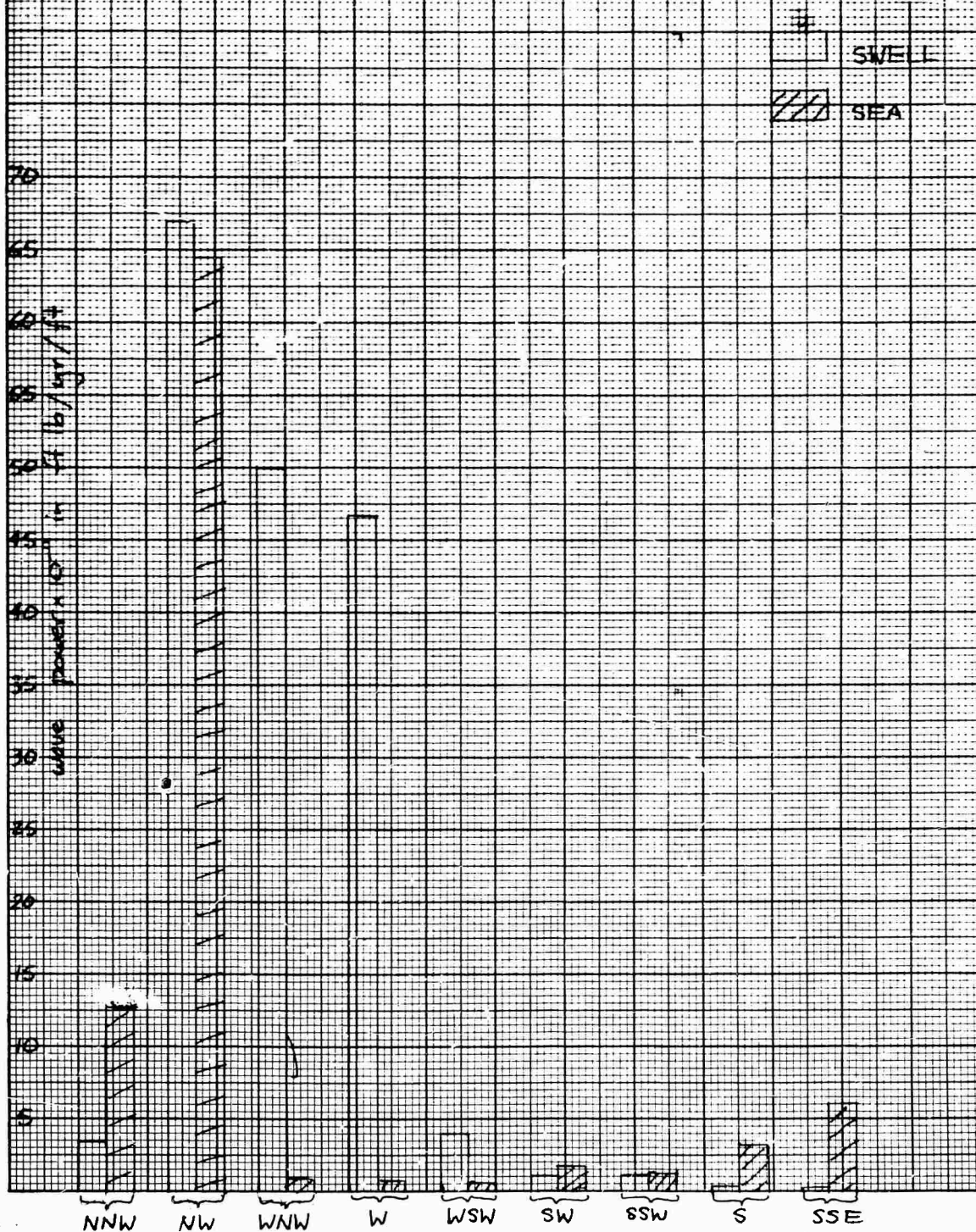


STATION 4 - CALIFORNIA COAST

Lat. 35.5°N , Long. 122.0°W

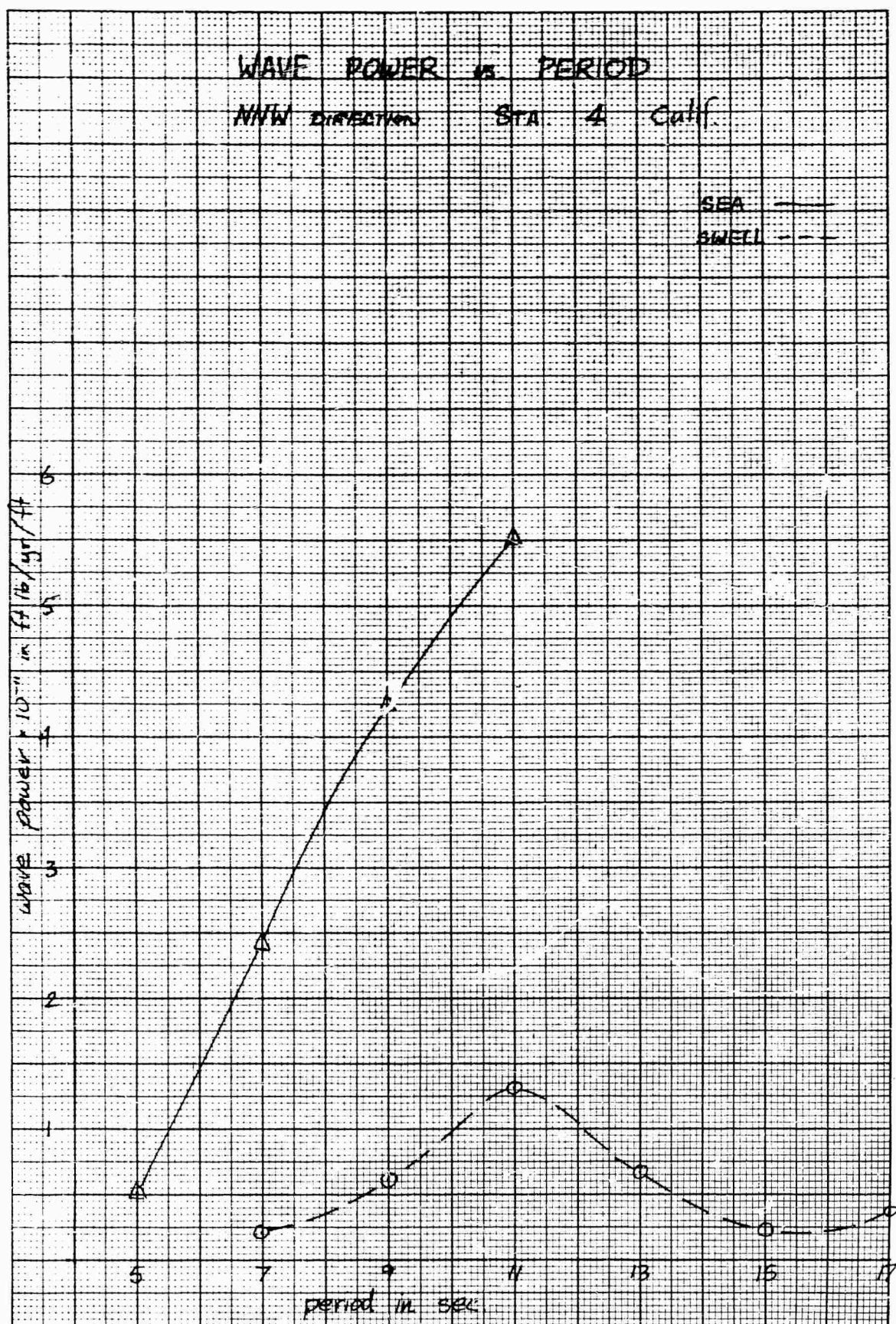
WAVE POWER vs. DIRECTION

CALIF. STA 4

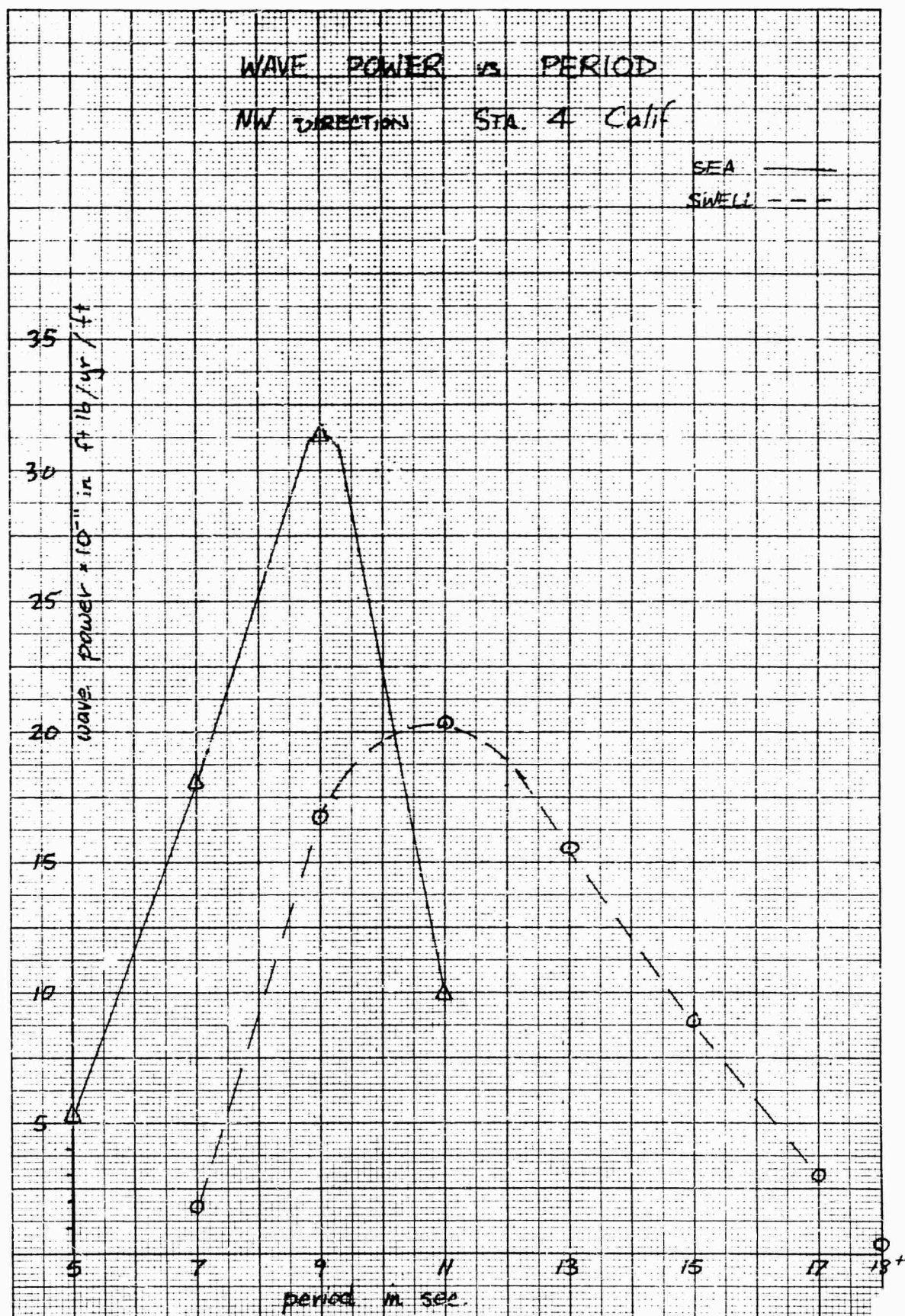


A-33

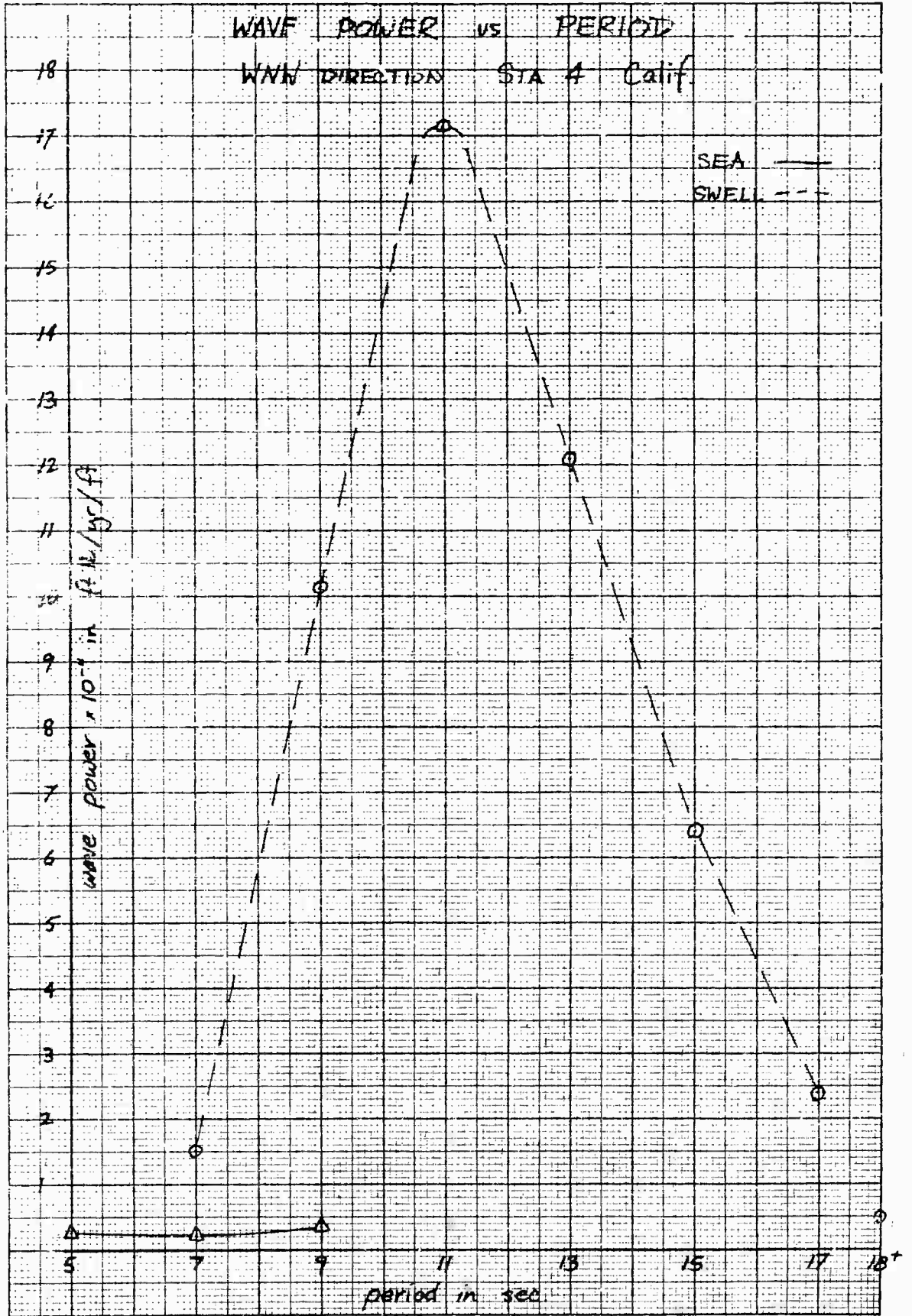
K-Σ 10 X 10 TO 1 1/2 INCH 46 1323
 "X" 10 INCHES "A" 10 7.5 A.
 KEUFTEL & FESSLER CO.



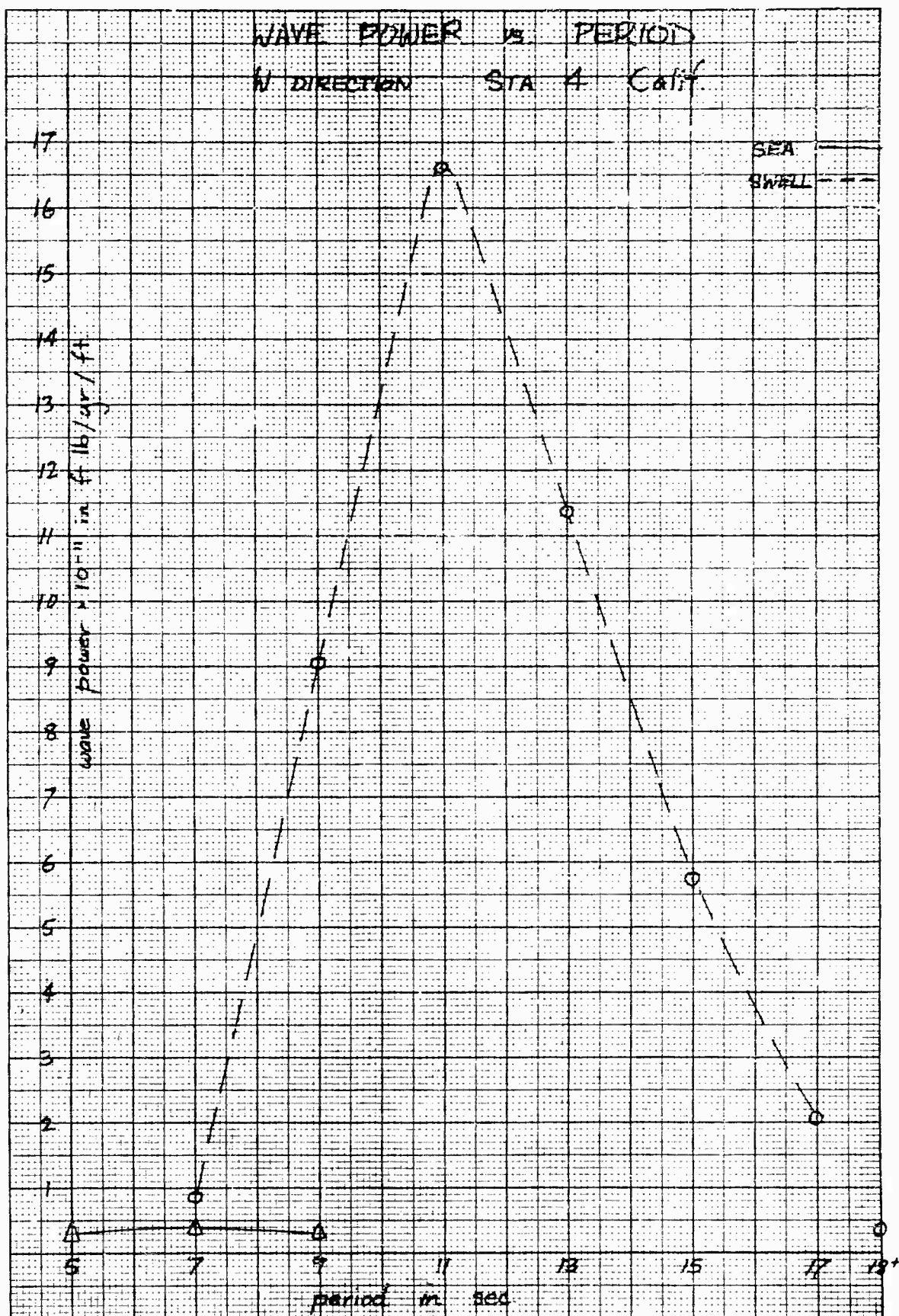
K&E 10 X 10 TO 1/2 INCH 46 1323
 1 1/2" x 1 1/2" INCH
 NEUPPGL 3 EASING CTS.



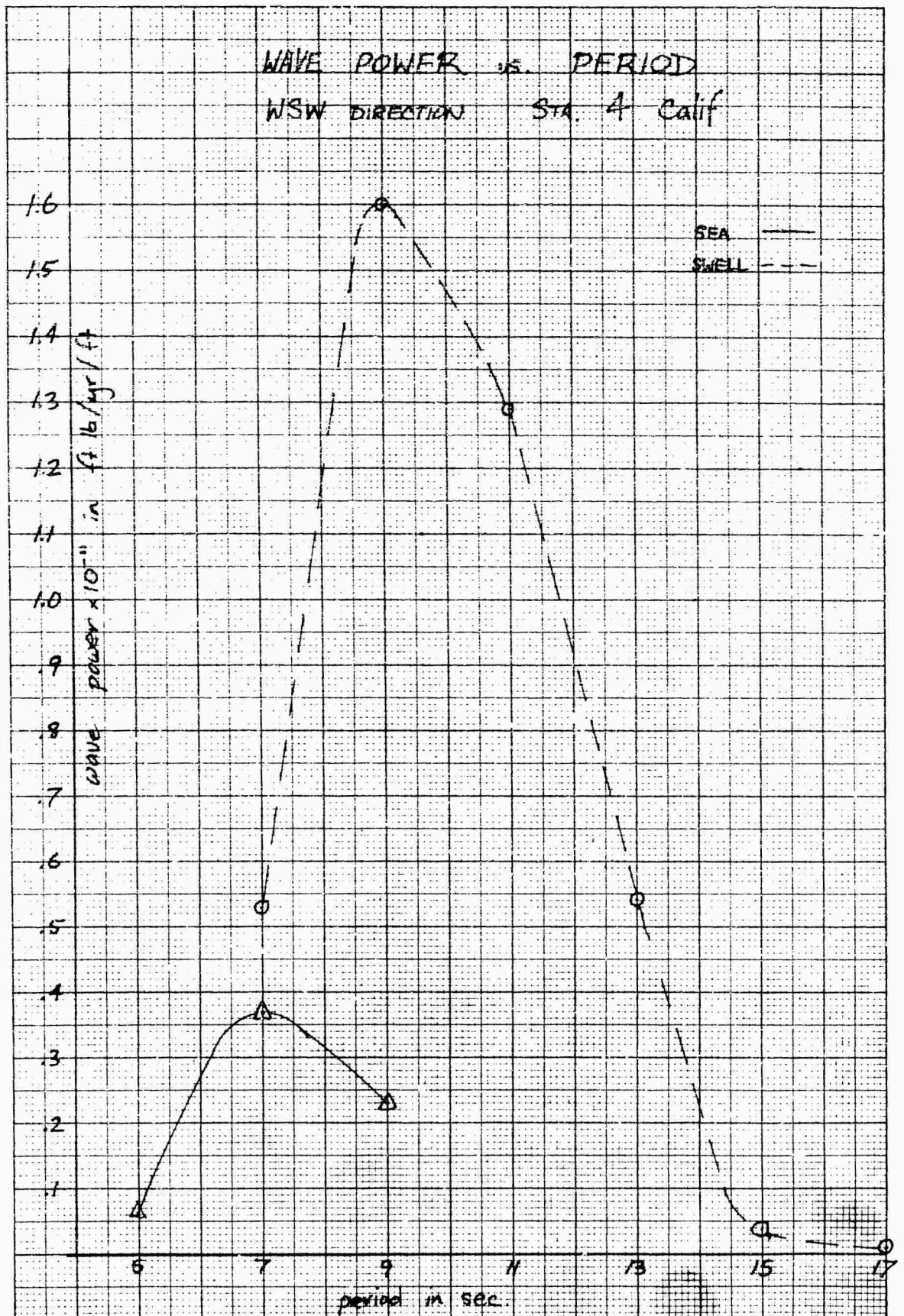
14-10 X 10 TO 1/2 INCH 46 1323
 14-10 X 10 TO 1/2 INCH 46 1323
 14-10 X 10 TO 1/2 INCH 46 1323



K&E 10 X 10 TO 1/2 INCH 46 1323
 7 X 1/2 INCH 46 1323
 KEUFFEL & ESSER CO.

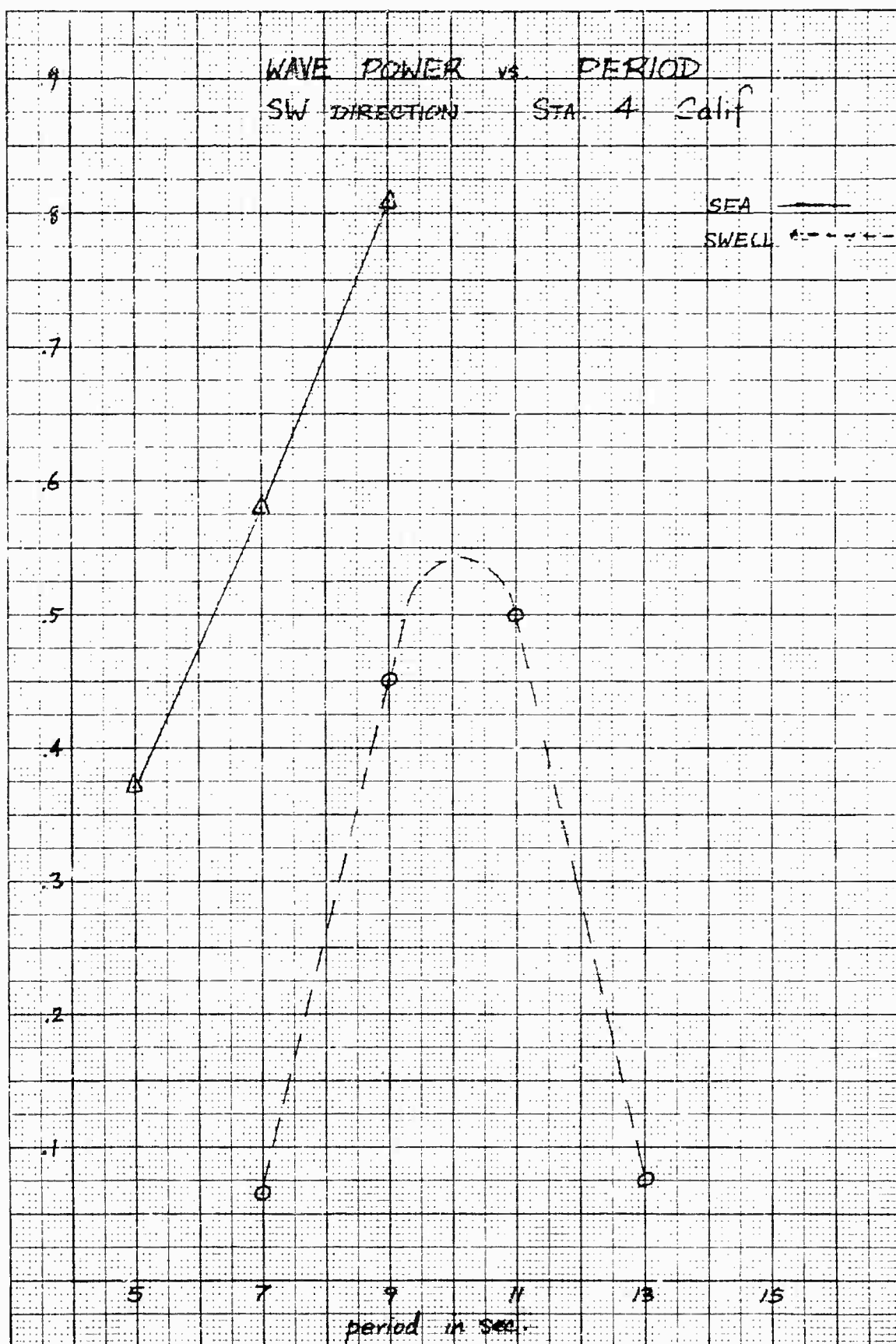


WAVE POWER vs. PERIOD
WSW DIRECTION STA. 4 Calif

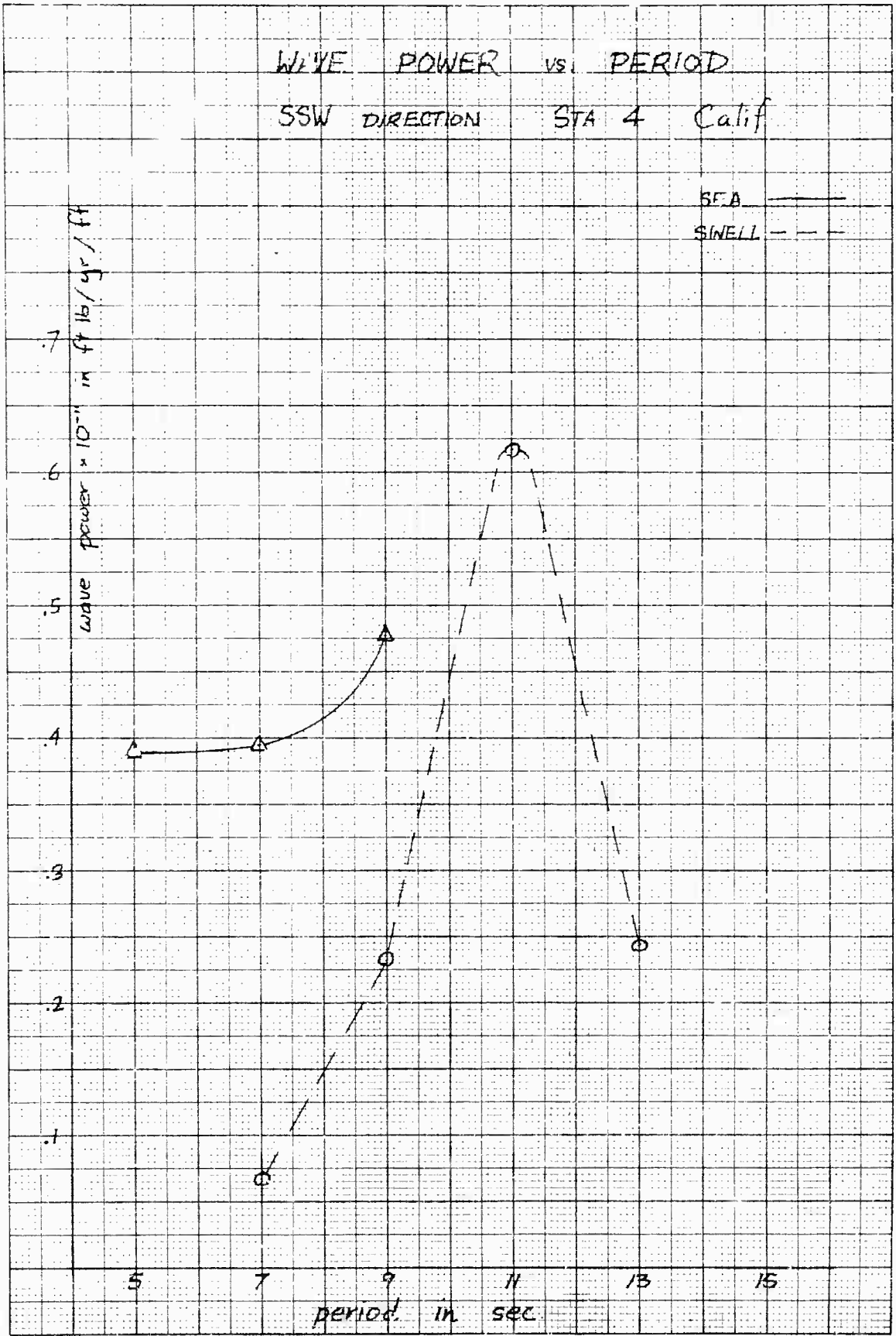


10 X 10 TO 1/2 INCH 46 1323
K&S
KLUFFEL & SISKY CO.

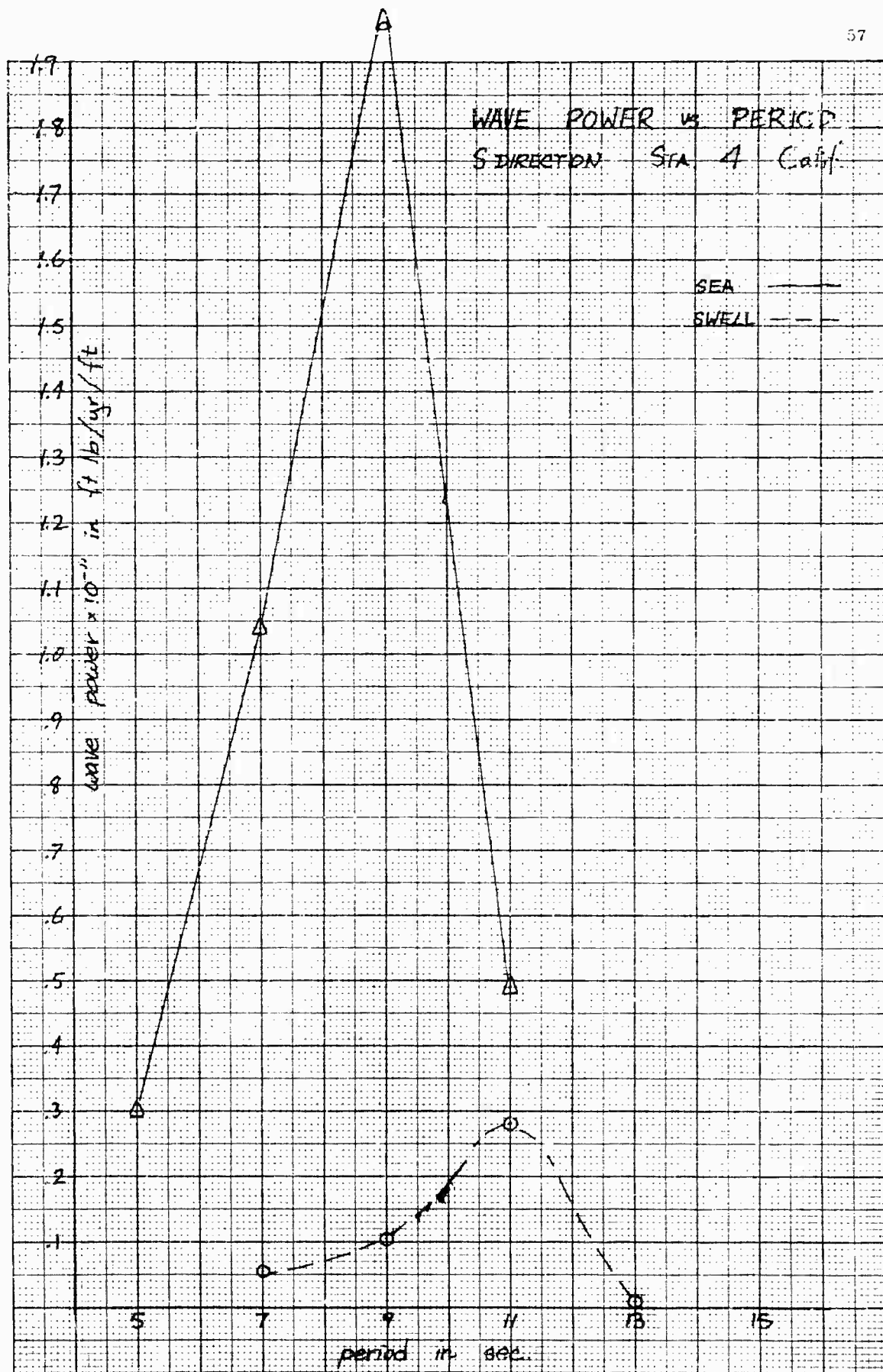
REF 10 X 10 TO 1 1/2 INCH 46 1323
KUPPERLE 1950-8-10



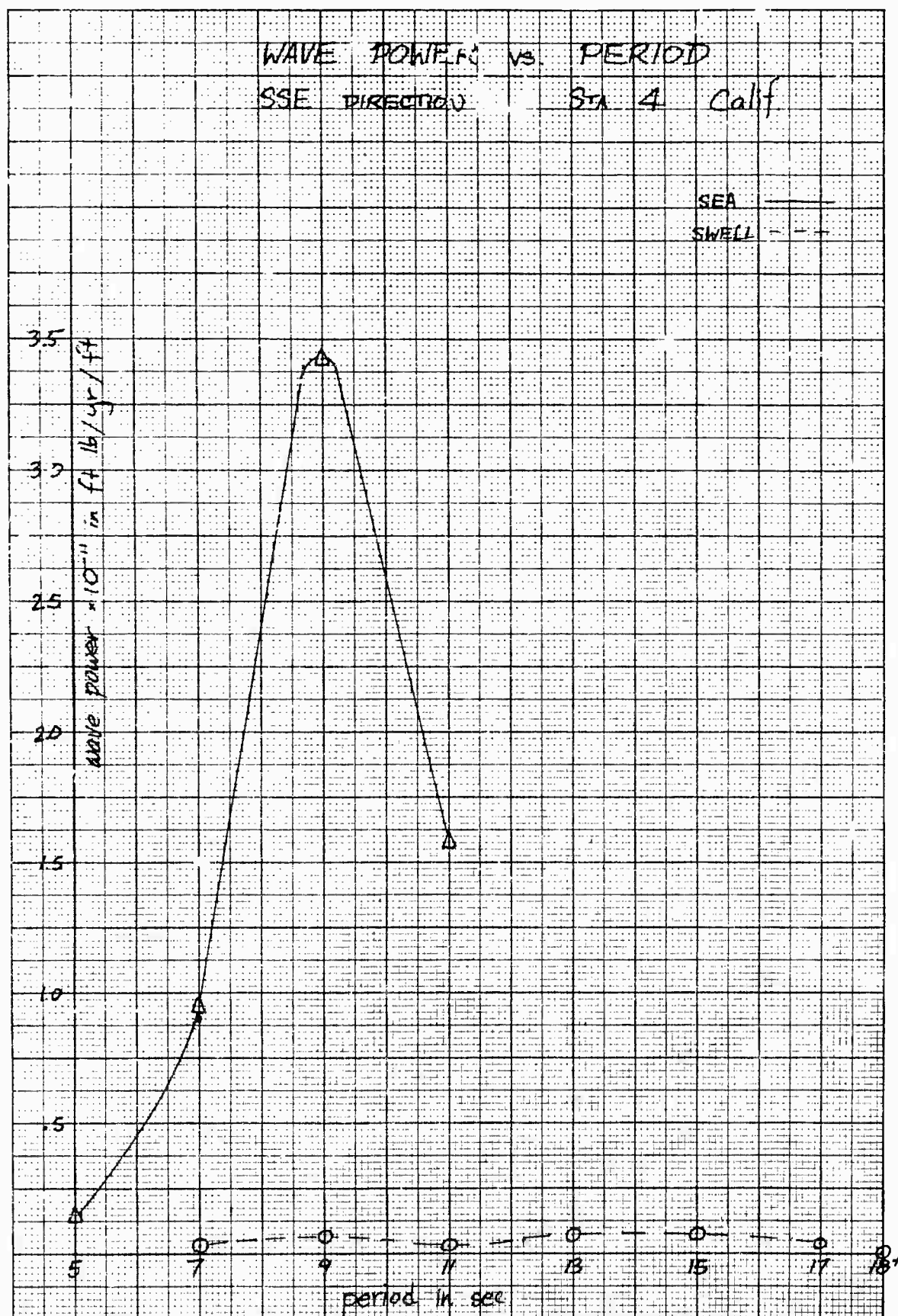
10 X 10 TO 1/2 INCH 46 1323
10 X 10 TO 1/2 INCH 46 1323
10 X 10 TO 1/2 INCH 46 1323



K&E 10 X 10 TO 1/2 INCH 46 1323
 KLUFFEL & KOSNER CO.



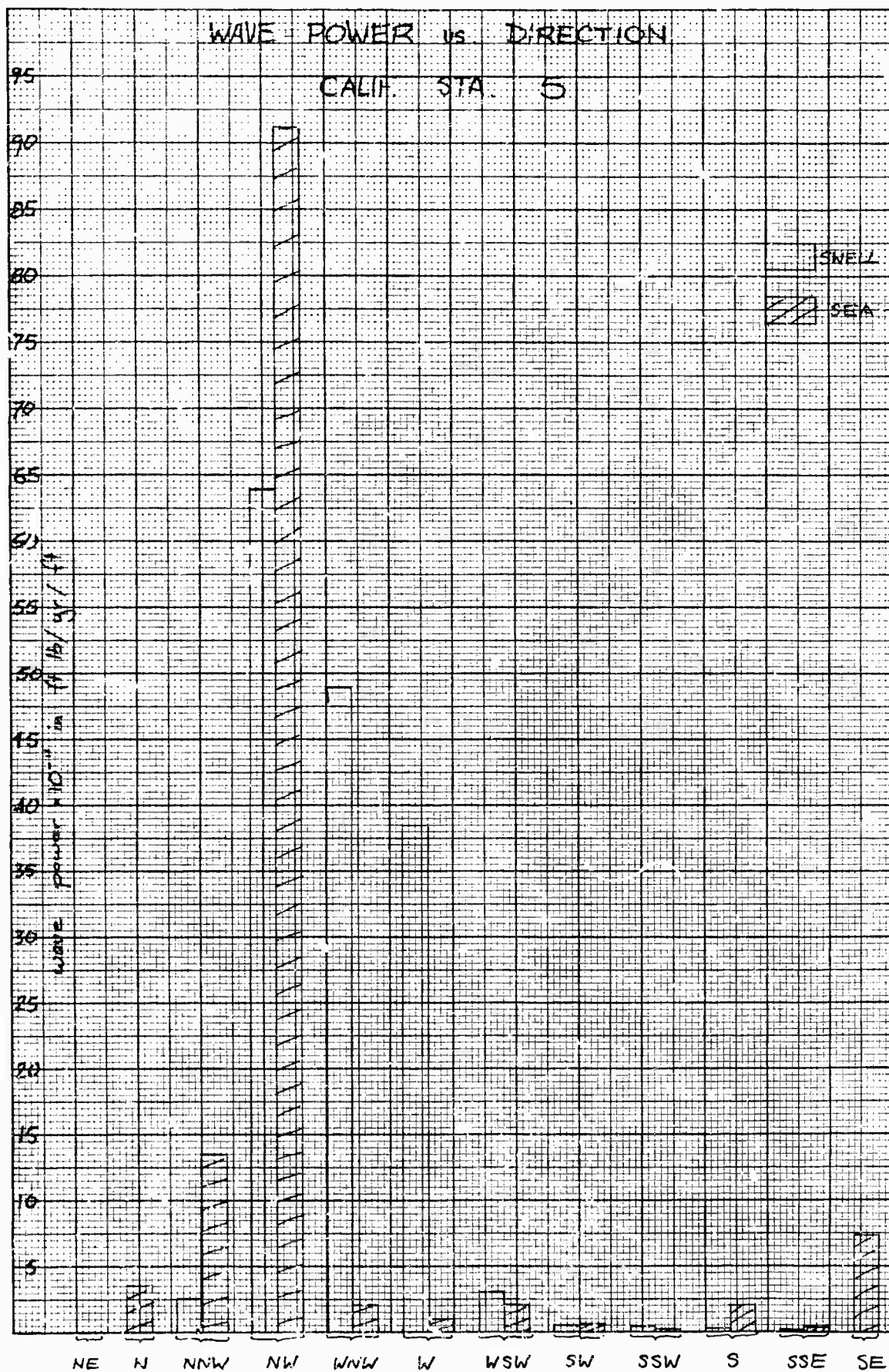
10 X 10 TO 1/2 INCH 46 1323
 7 X 6 INCH 46 1323
 KUOFFEL & BURCH



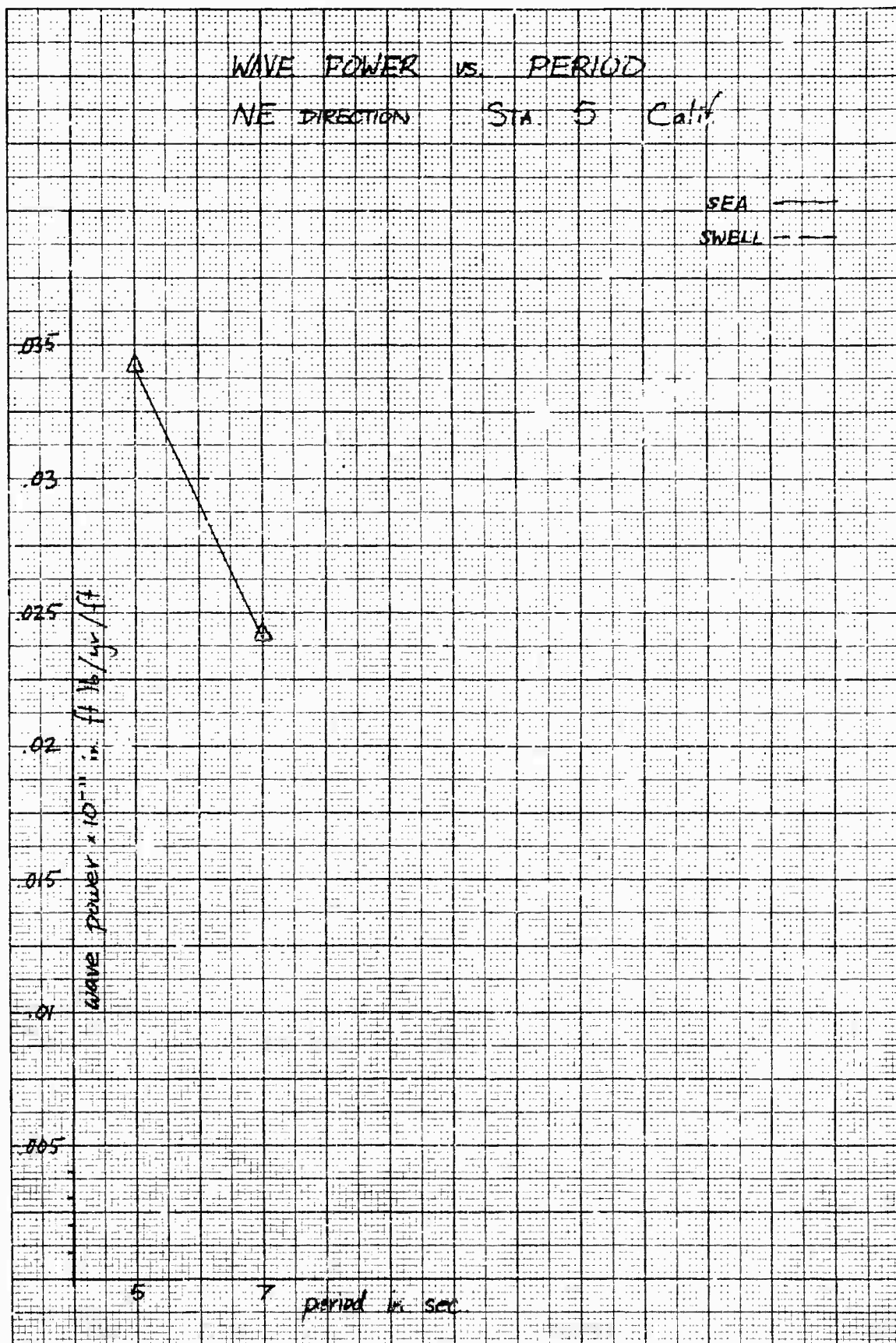
STATION 5 - CALIFORNIA COAST

Lat. 34.5°N , Long. 121.0°W

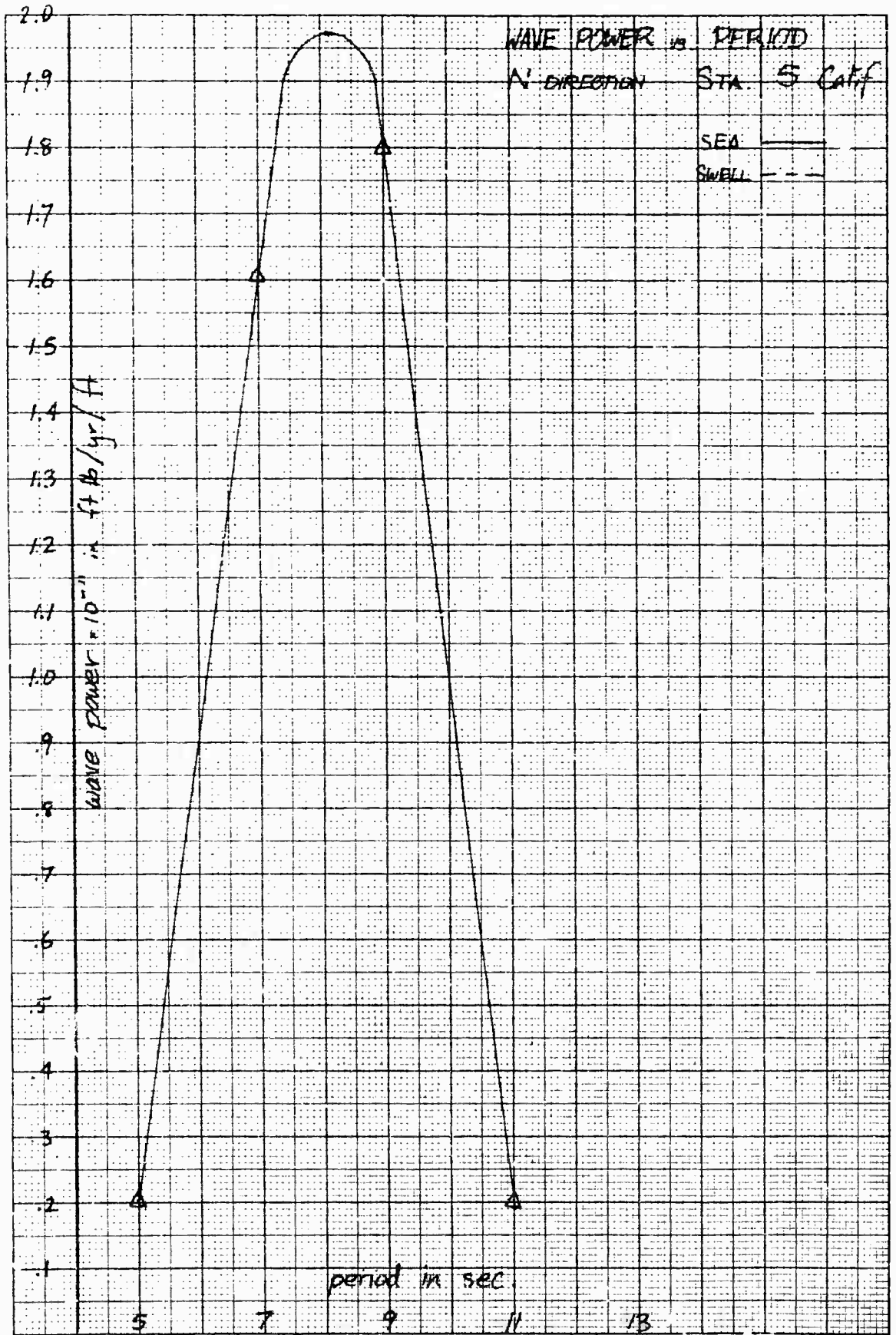
10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFEL & ESPEY CO.



K&E 10 X 10 TO 1/2 INCH 46 1323
 1/2 X 10 INCHES
 KEUFFEL & ESSER CO.



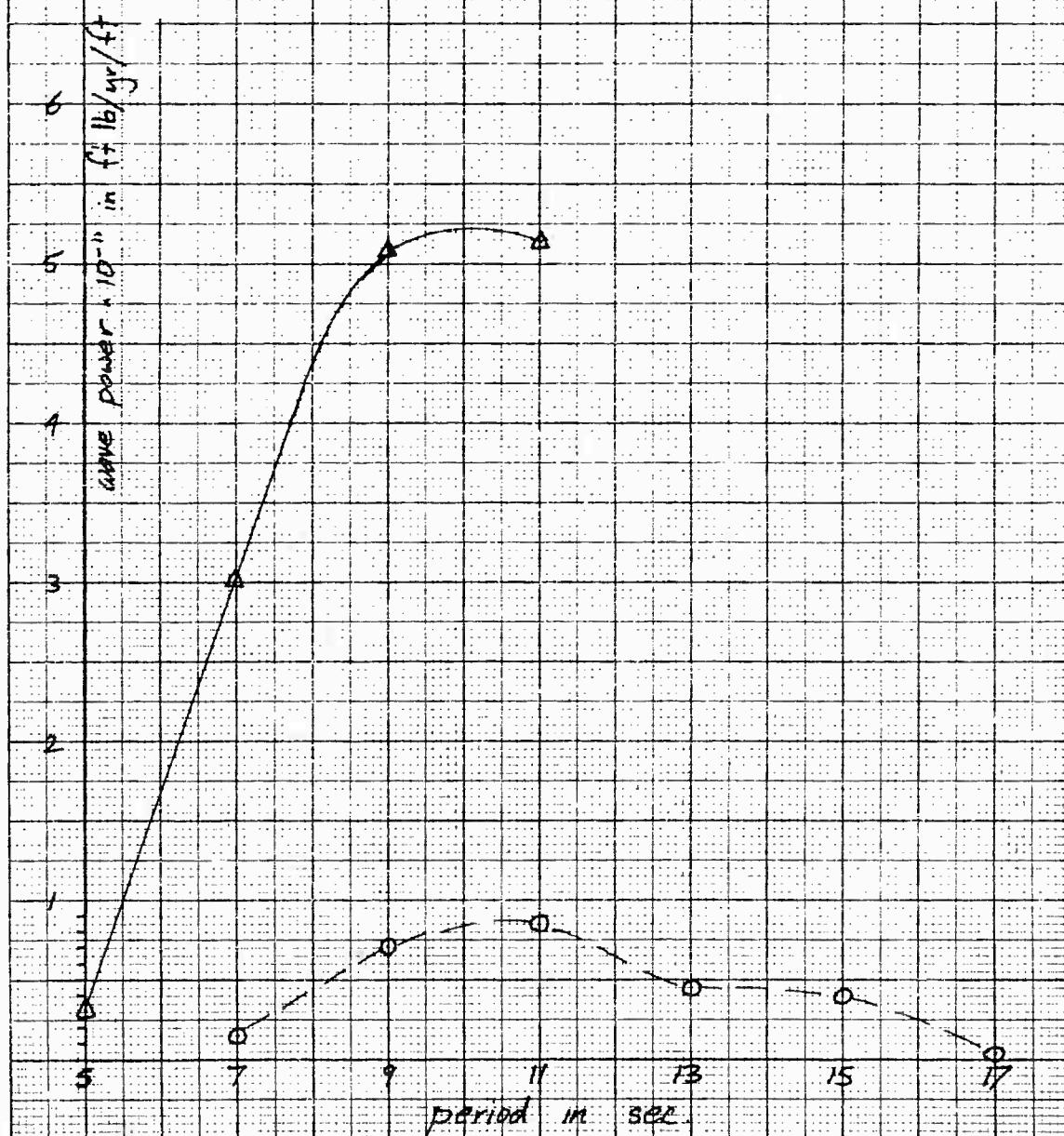
KE 10 x 10 TO 1 1/2 INCH 46 1323
 U.S. DEPT. OF COMMERCE
 GULFPORT, MISSISSIPPI



WAVE POWER vs PERIOD

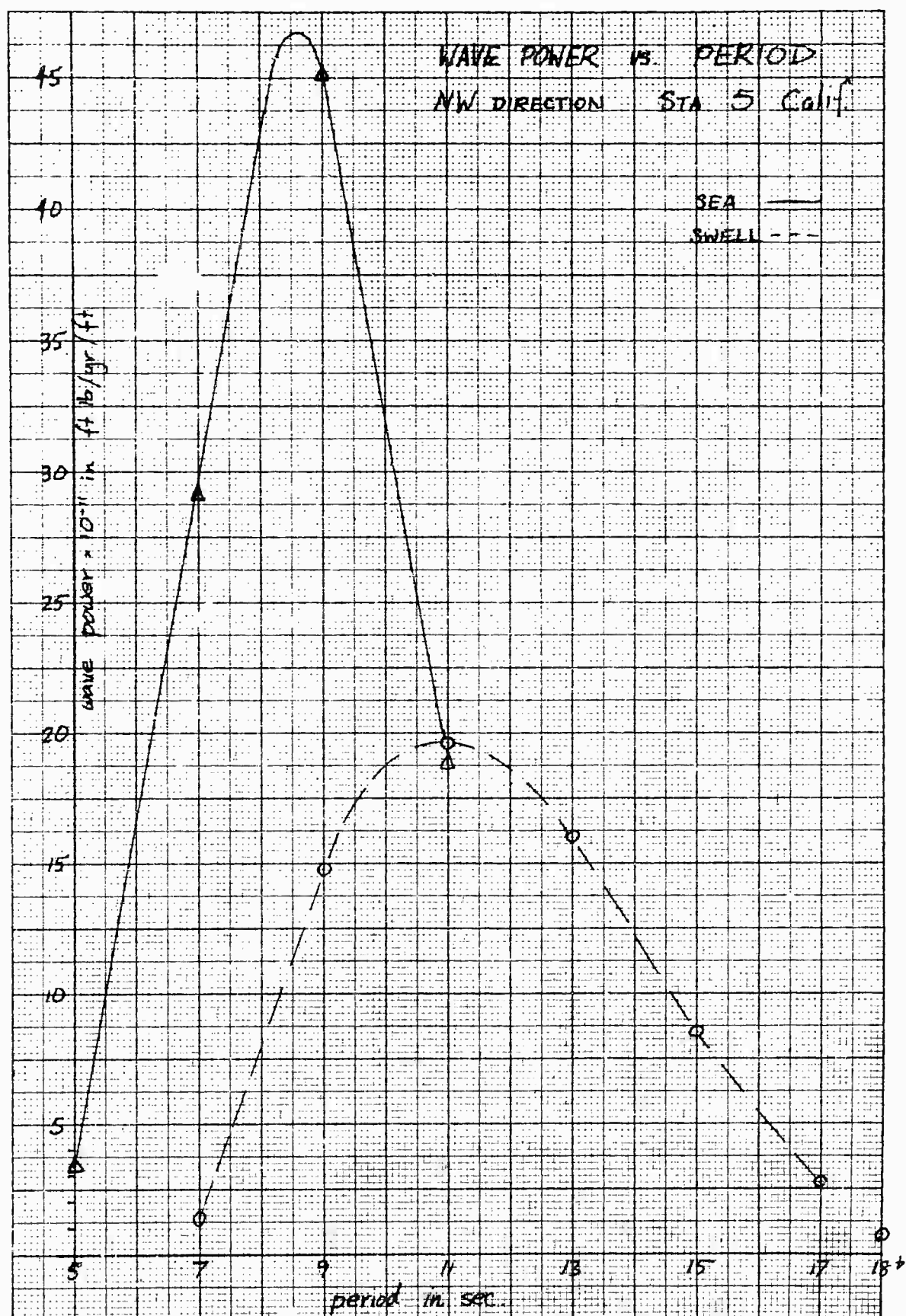
NNW DIRECTION STA 5 Calif.

SEA ———
SWELL - - -

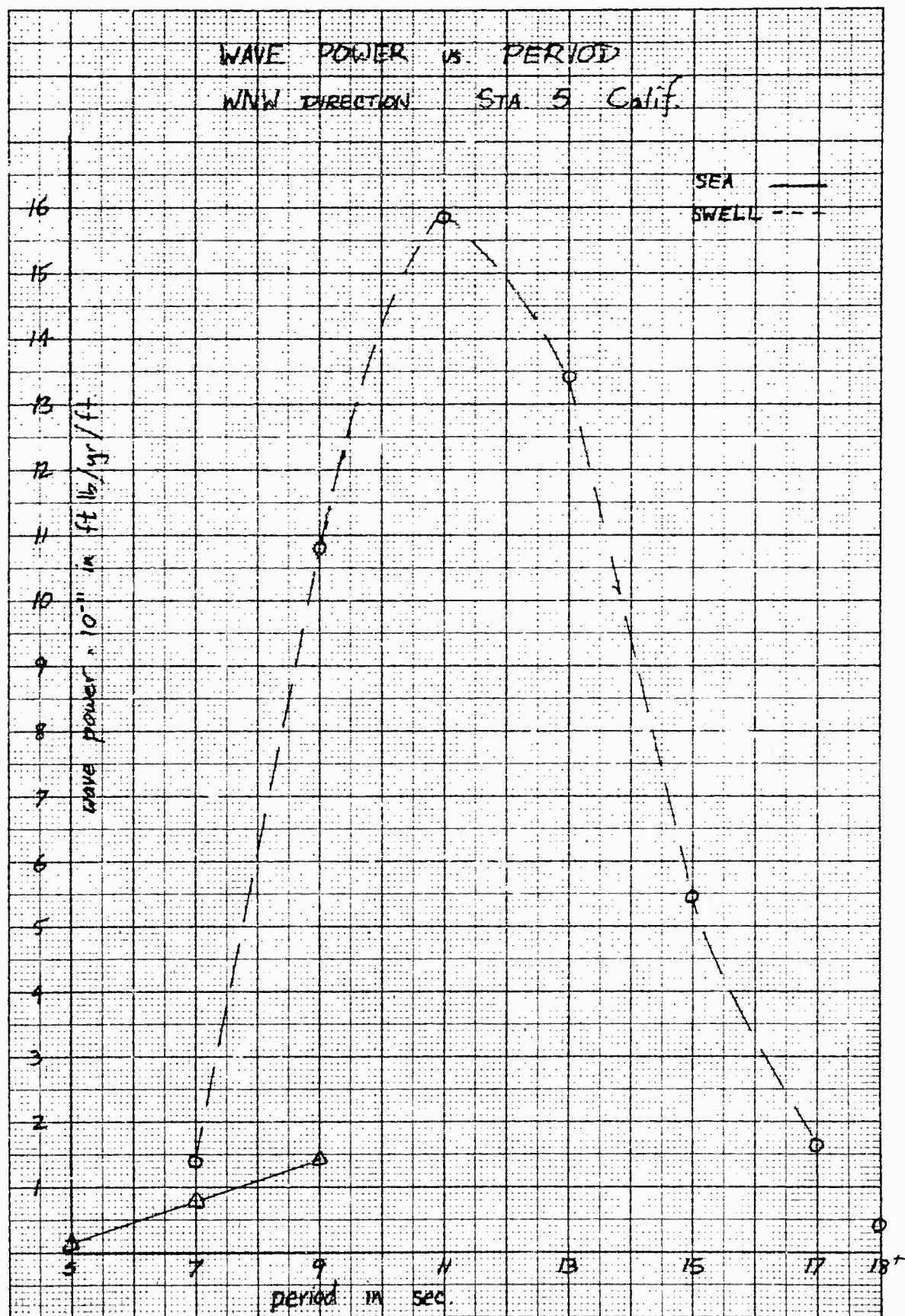


K&E 10 X 10 TO 1/4 INCH 46 1323
K&E ENGINEERING CO. CALIF. U.S.A.
KEUFFEL & BENTON CO.

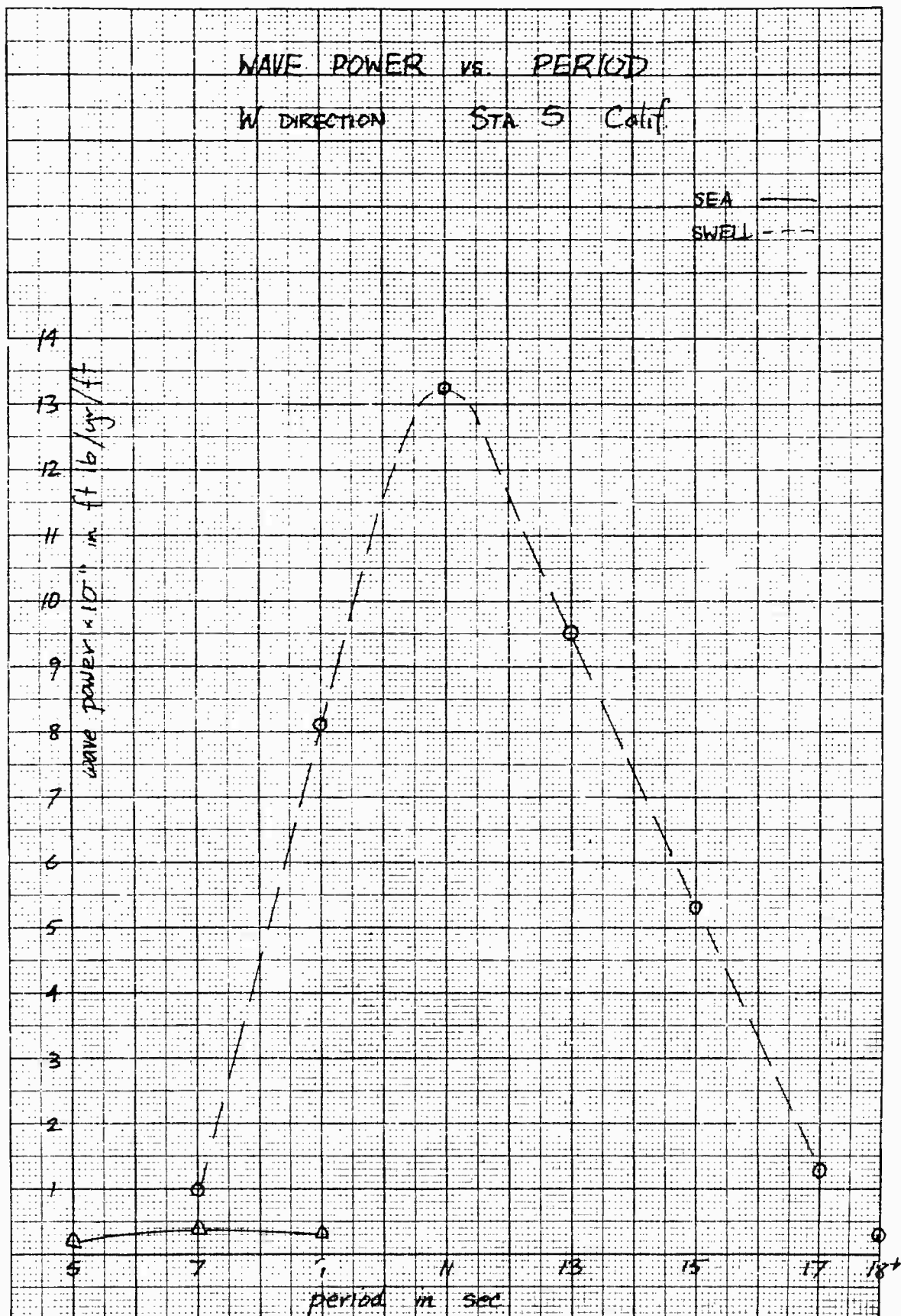
K&E 12 x 10 to 12 inch 46 1323
 1 1/2 x 1 1/2 inches
 REUFFEL & SONS CO.



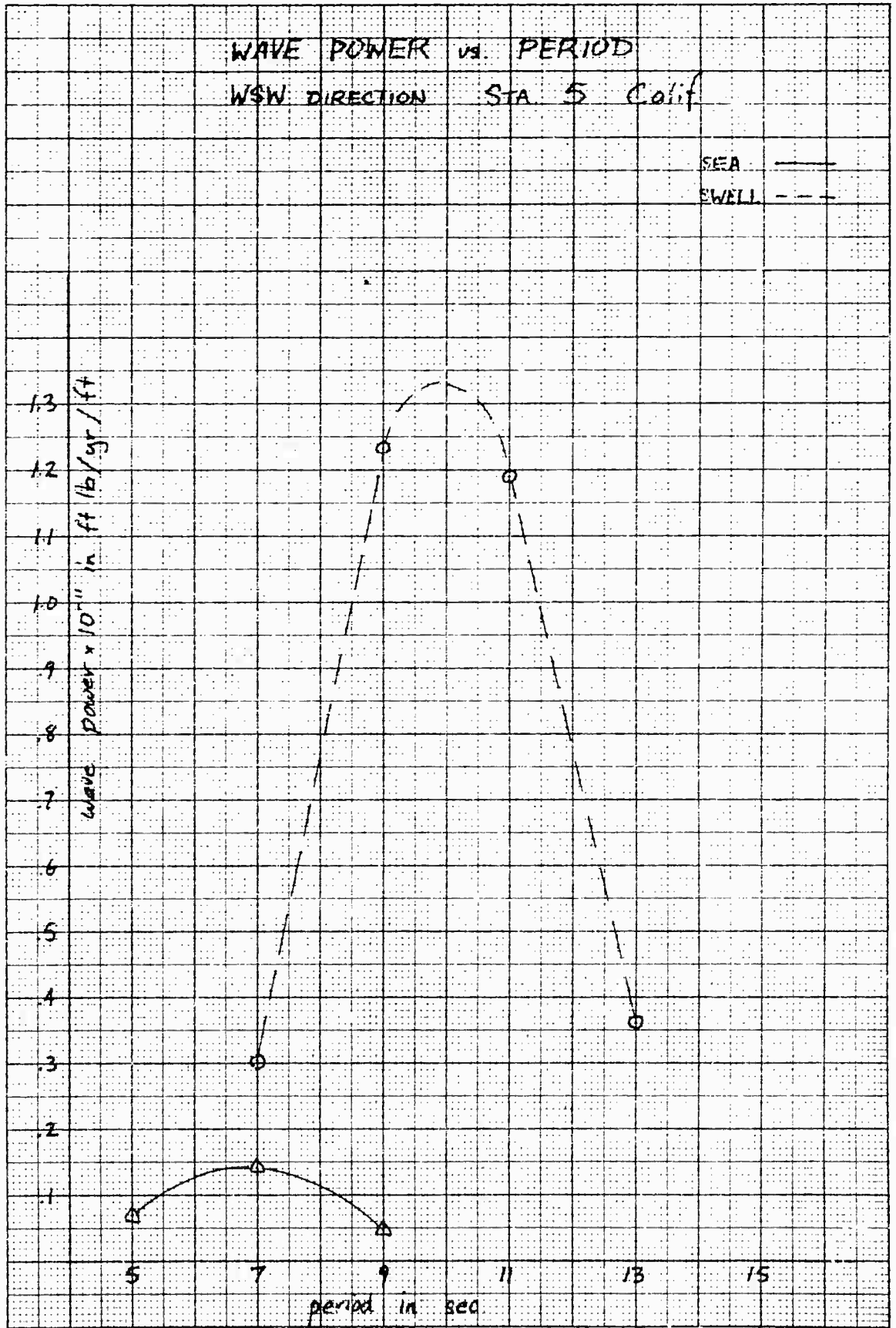
K&E 10 x 10 to 1 1/2 inch 46 1323
7 1/2 inch
KUFFEL & ESSER CO.



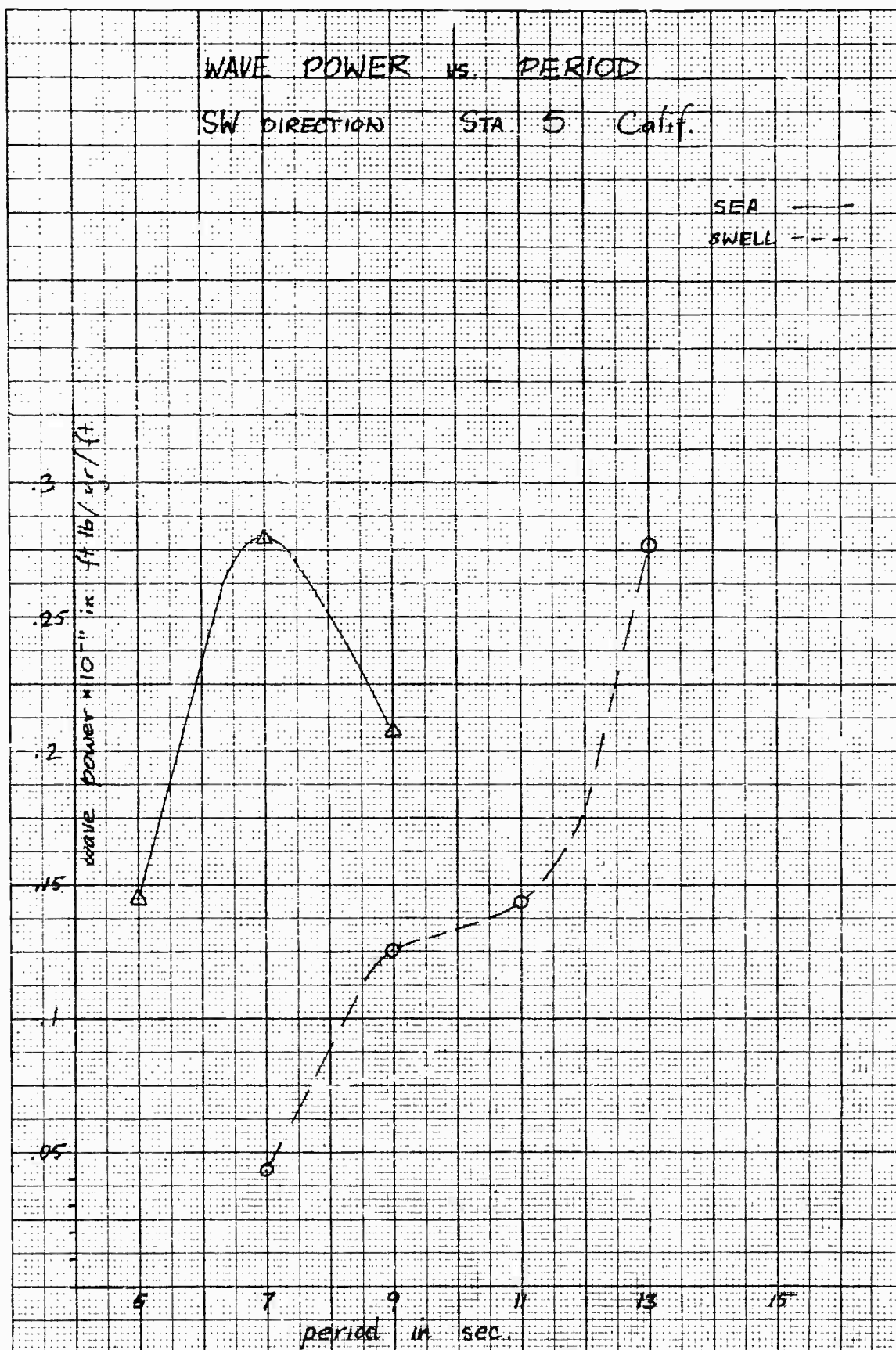
K&S 10 X 10 TO 1 1/2 INCH 46 1323
ALUMINUM
ALUMINUM & BRASS

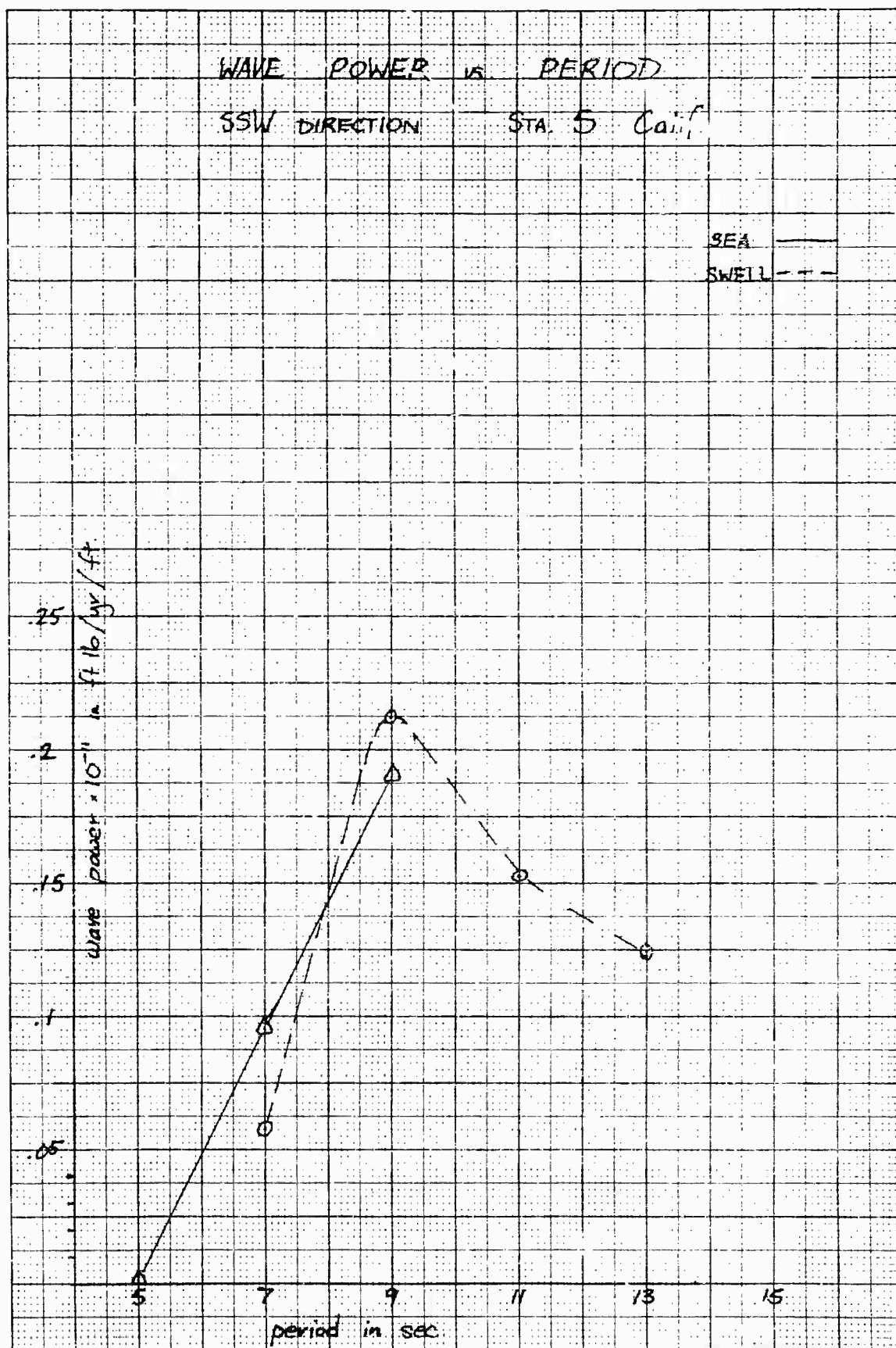


K&E 10 X 10 TO 1 1/2 INCH 46 1323
K&E 10 X 10 TO 1 1/2 INCH 46 1323
K&E 10 X 10 TO 1 1/2 INCH 46 1323

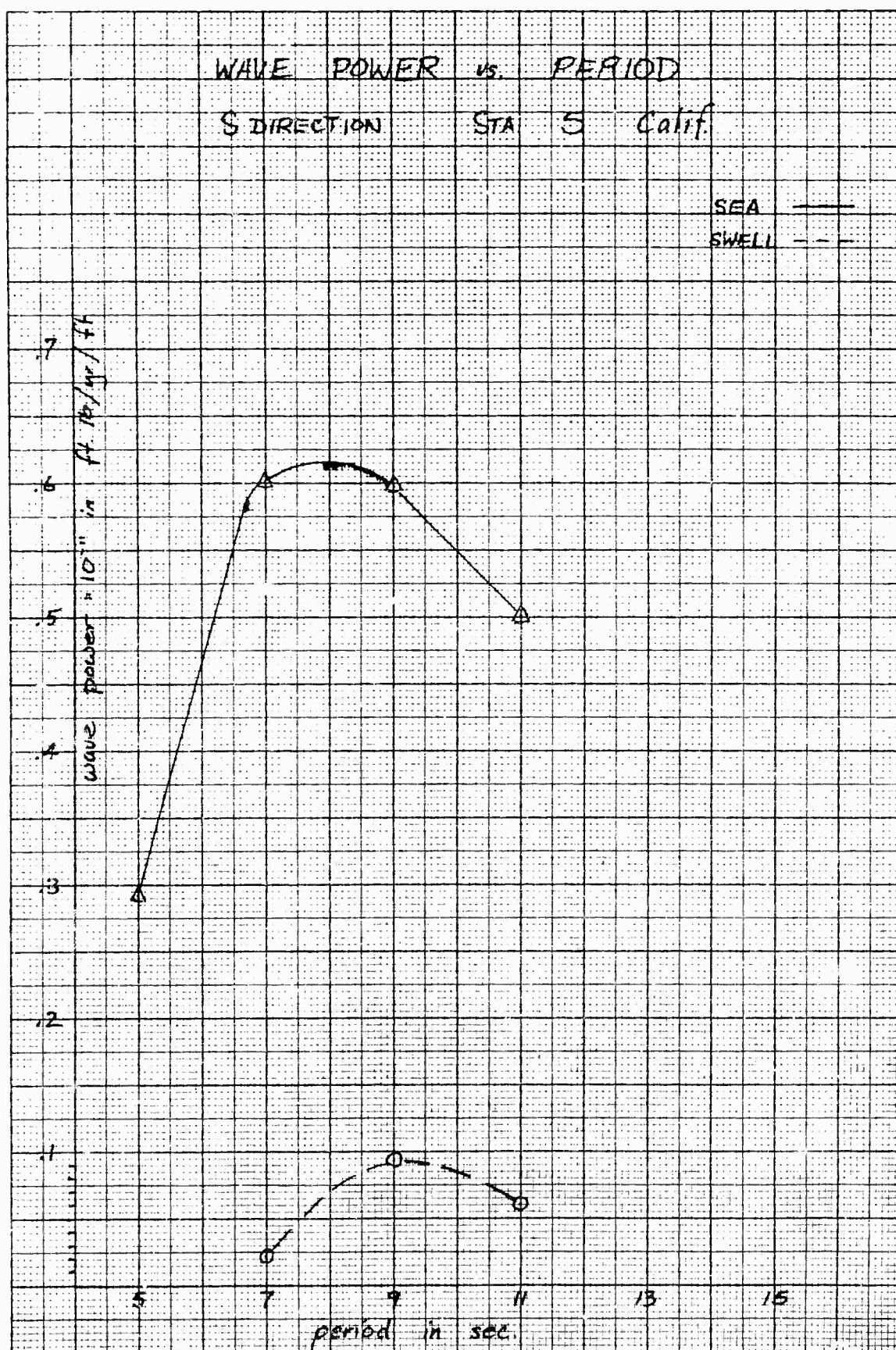


K&E 10 X 10 TO 1 1/2 INCH 46 1323
 MADE IN U.S.A.
 K&E ENGINEERING CO.

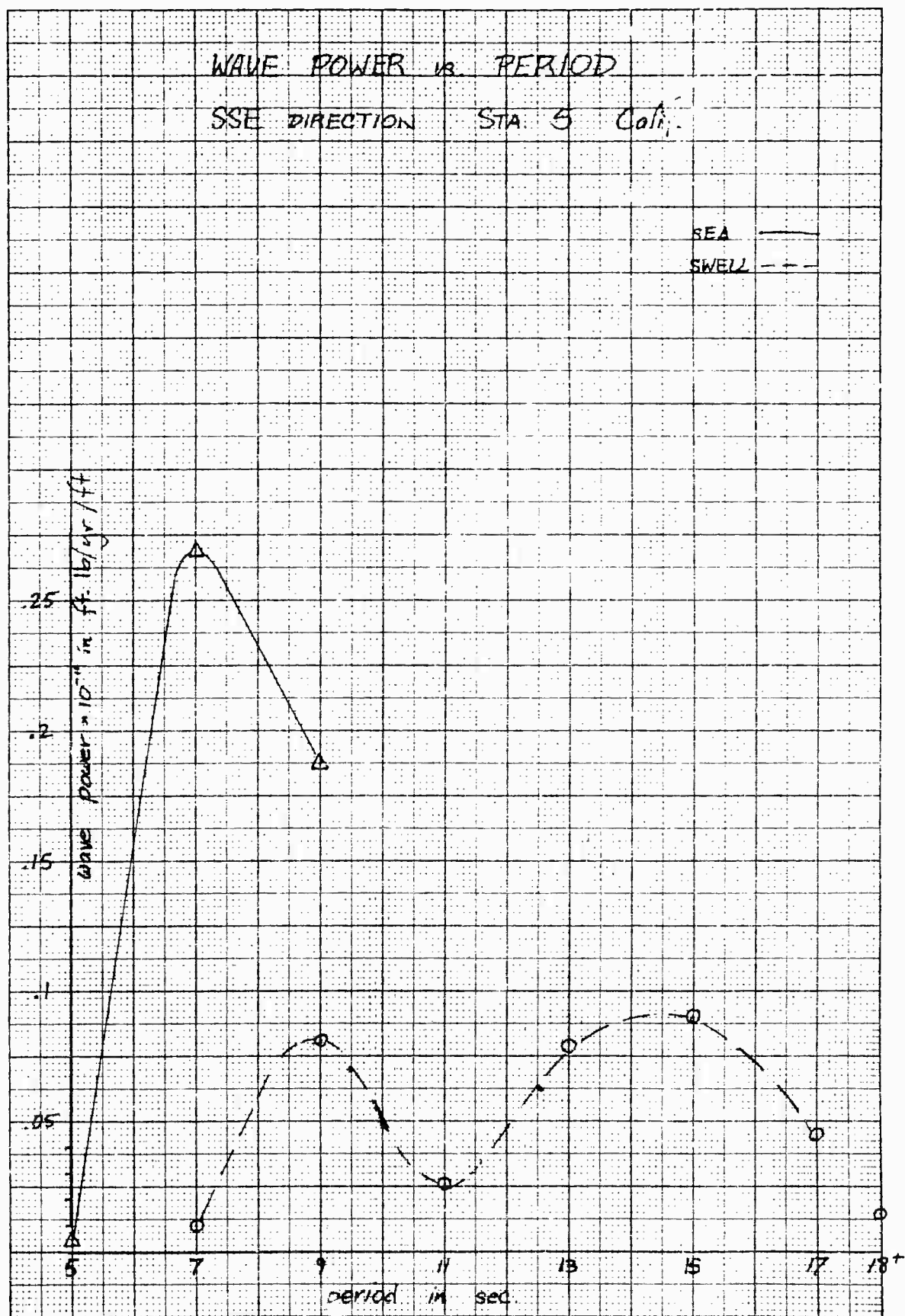




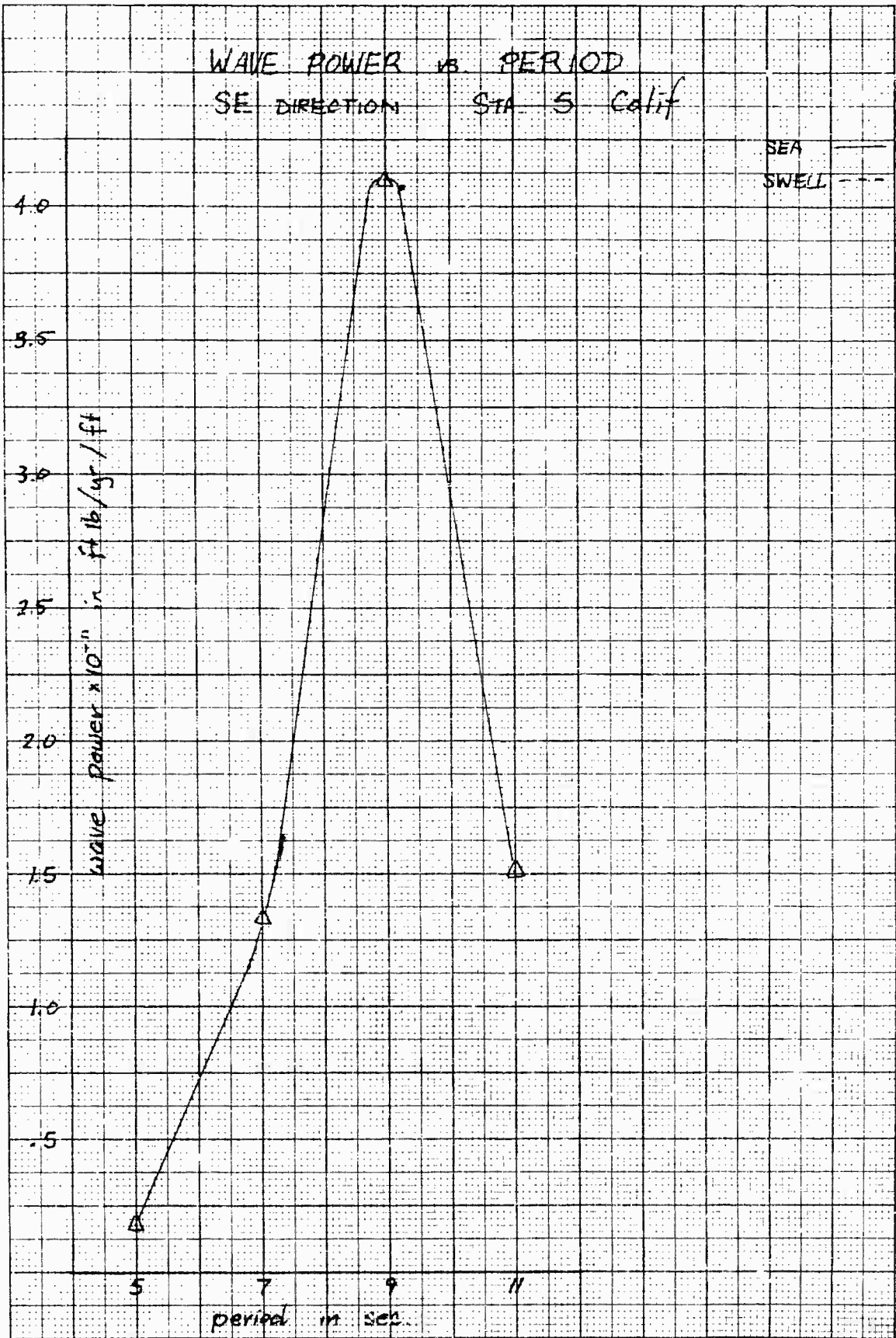
K&E 10 X 10 TO 1 1/2 INCH 46 1323
 7 X 10 INCHES 46 1323
 KEUFFEL & ESSER CO.



K₂ 10 X 10 TO 1 1/2 INCH 46 1323
 1 1/2 INCHES 46 1323
 KUPPEL & PONSER CO.



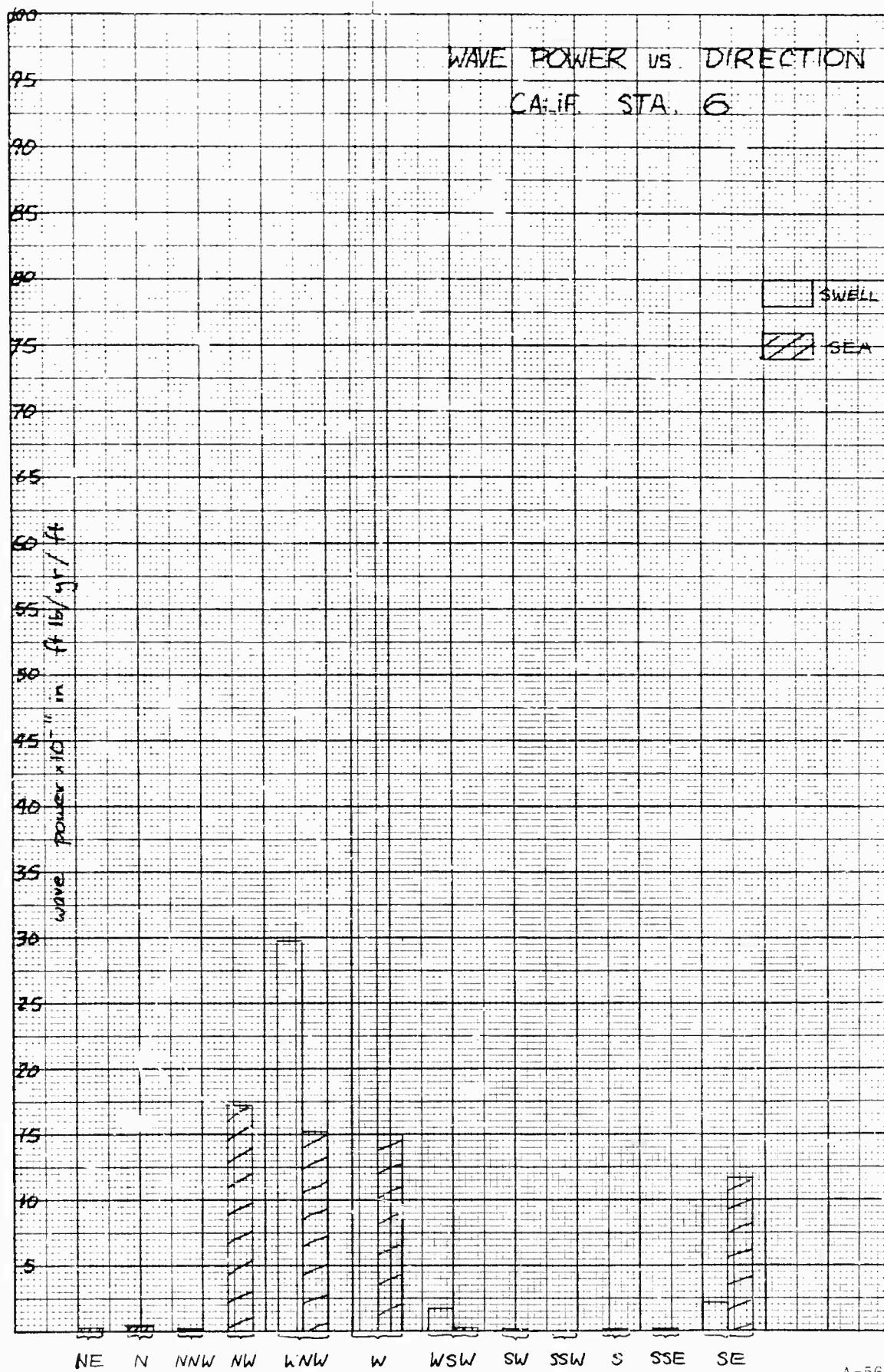
K&E 10 X 10 TO 12 INCH 46 1323
NATIONAL BUREAU OF STANDARDS



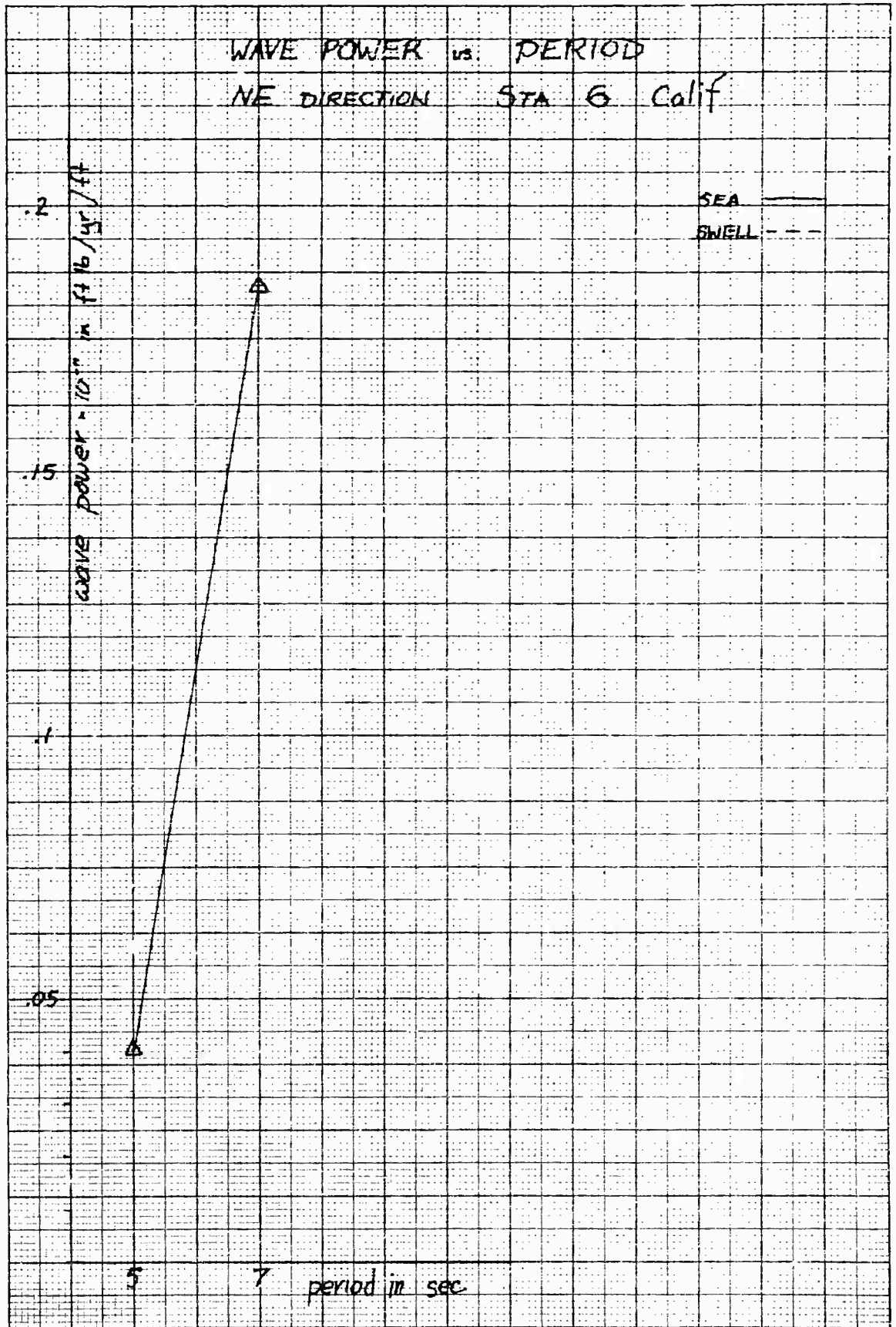
STATION 6 - CALIFORNIA COAST

Lat. 34.2°N , Long. 120.0°W

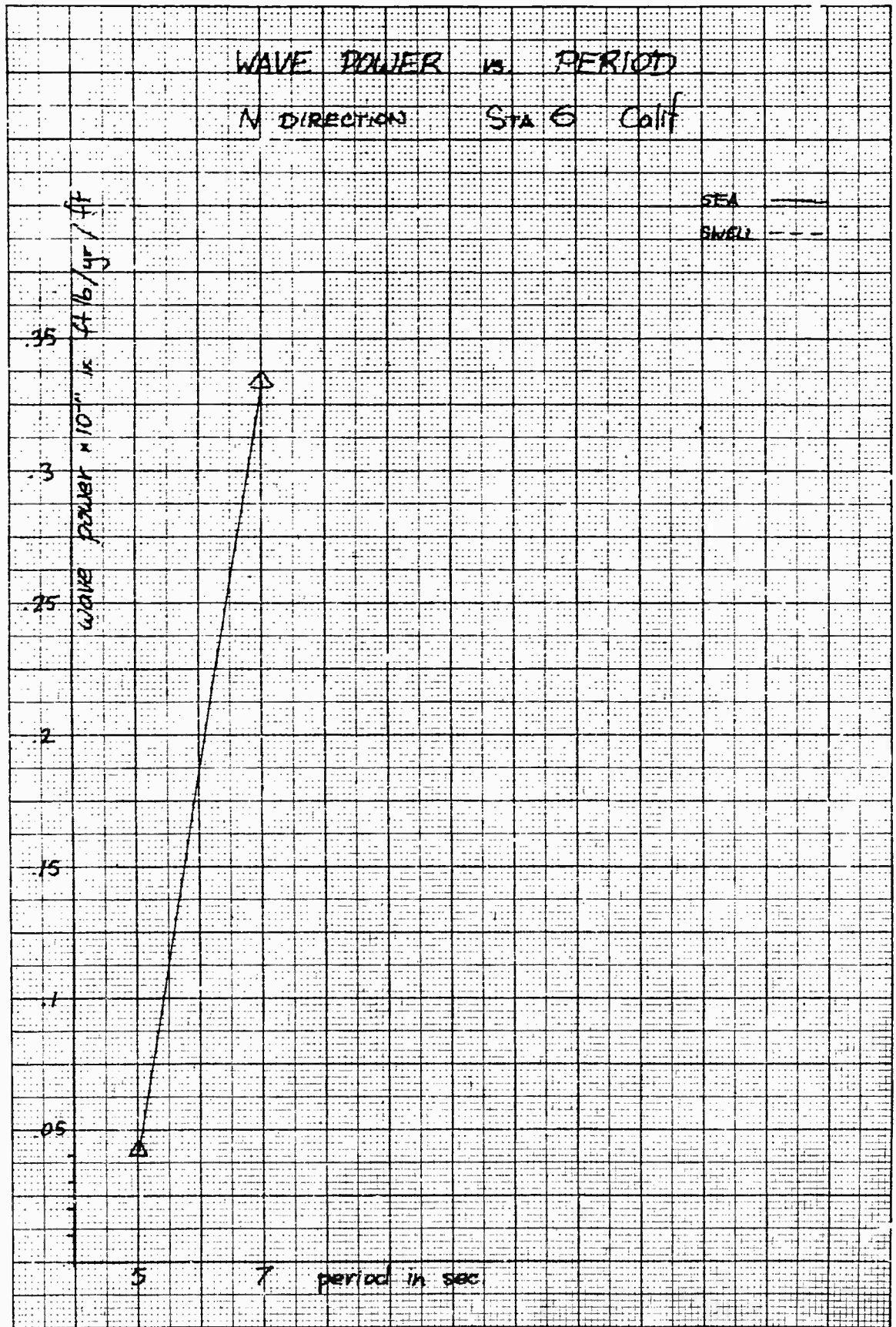
K&E 10 X 10 TO 1/2 INCH 46 1323
X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO



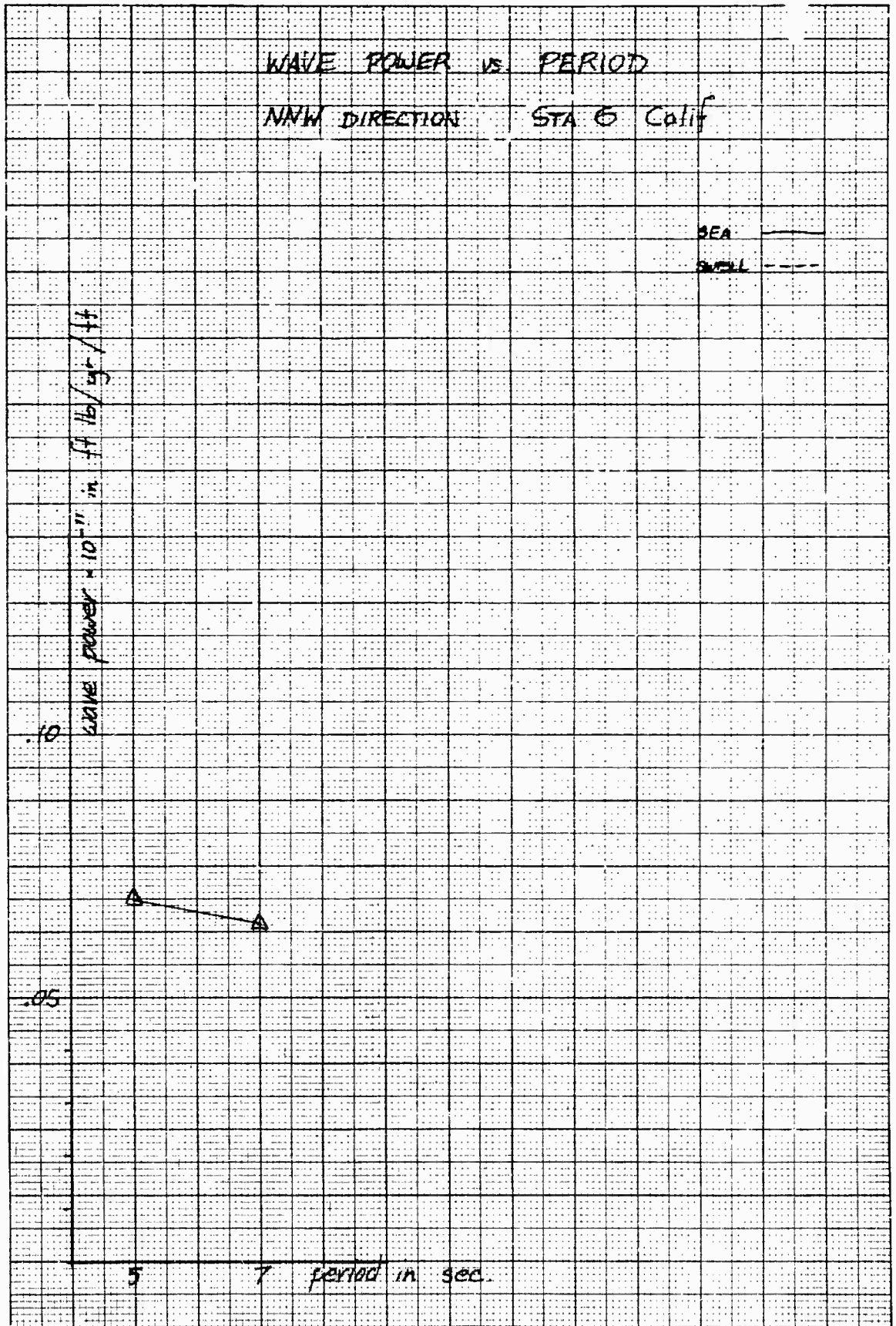
K&E 10 X 10 TO 1 1/2 INCH 46 1323
 "X" 1/2 INCH
 KEUFFEL & ESSER CO.



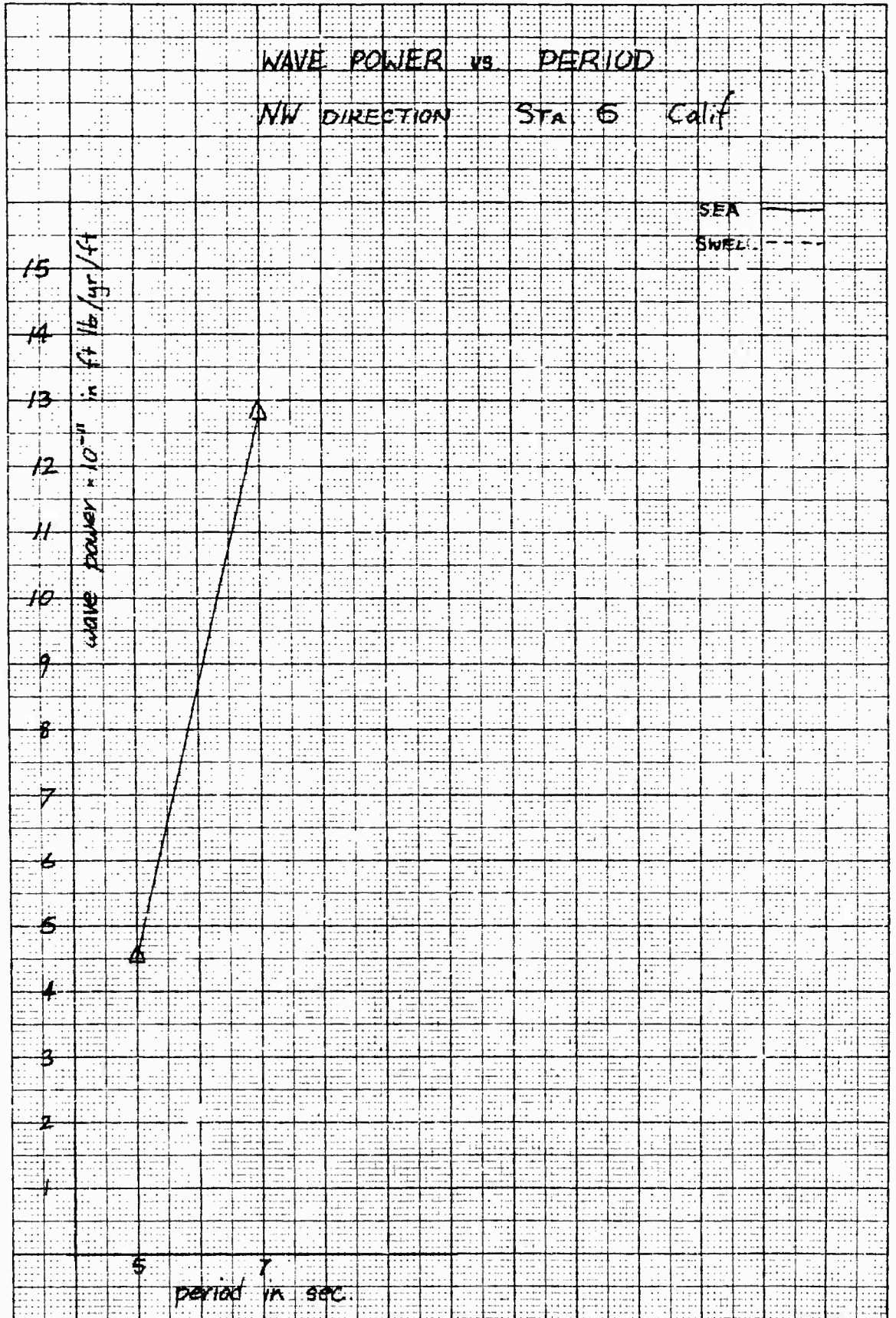
K&E 10 x 10 to 1 1/2 inch 46 1323
MADE IN U.S.A.
 KEUFFEL & ESSER CO.



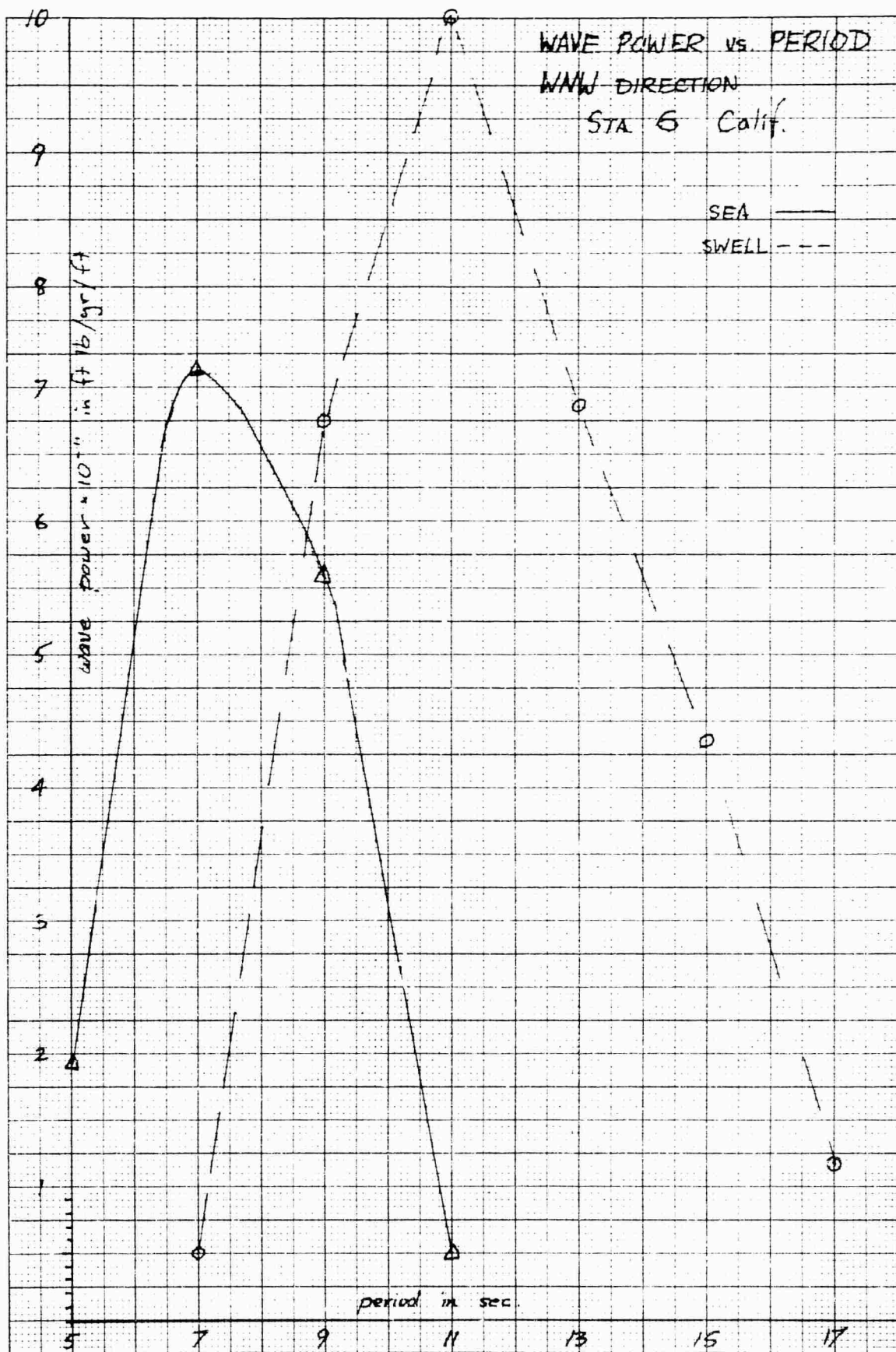
K&E 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.



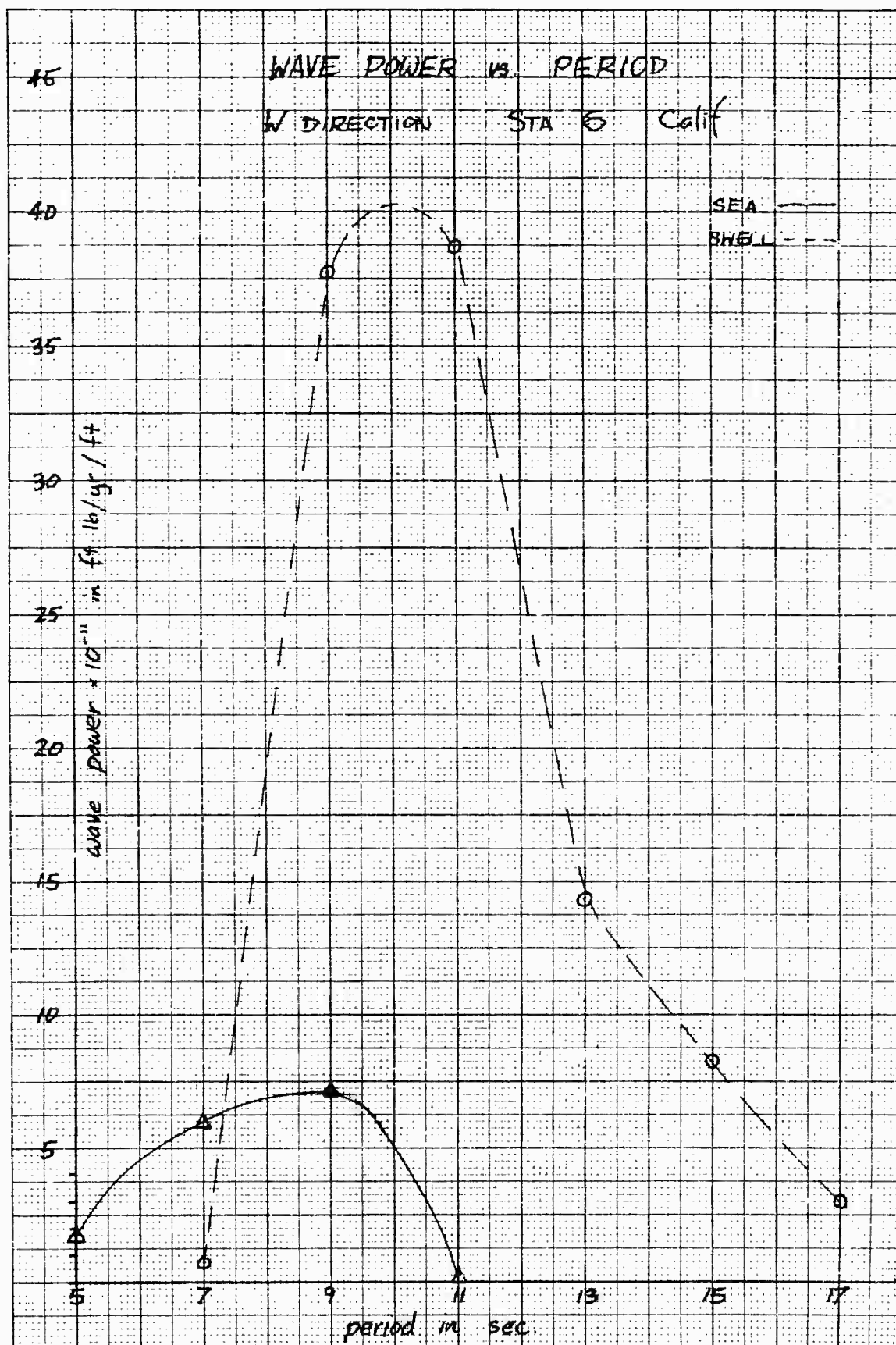
K&E 12 X 10 TO 1 1/2 INCH 46 1323
 1 1/2 X 10 INCH 46 1323
 KENNEDY & ESSLER CO.
 ALBANY, N. Y.



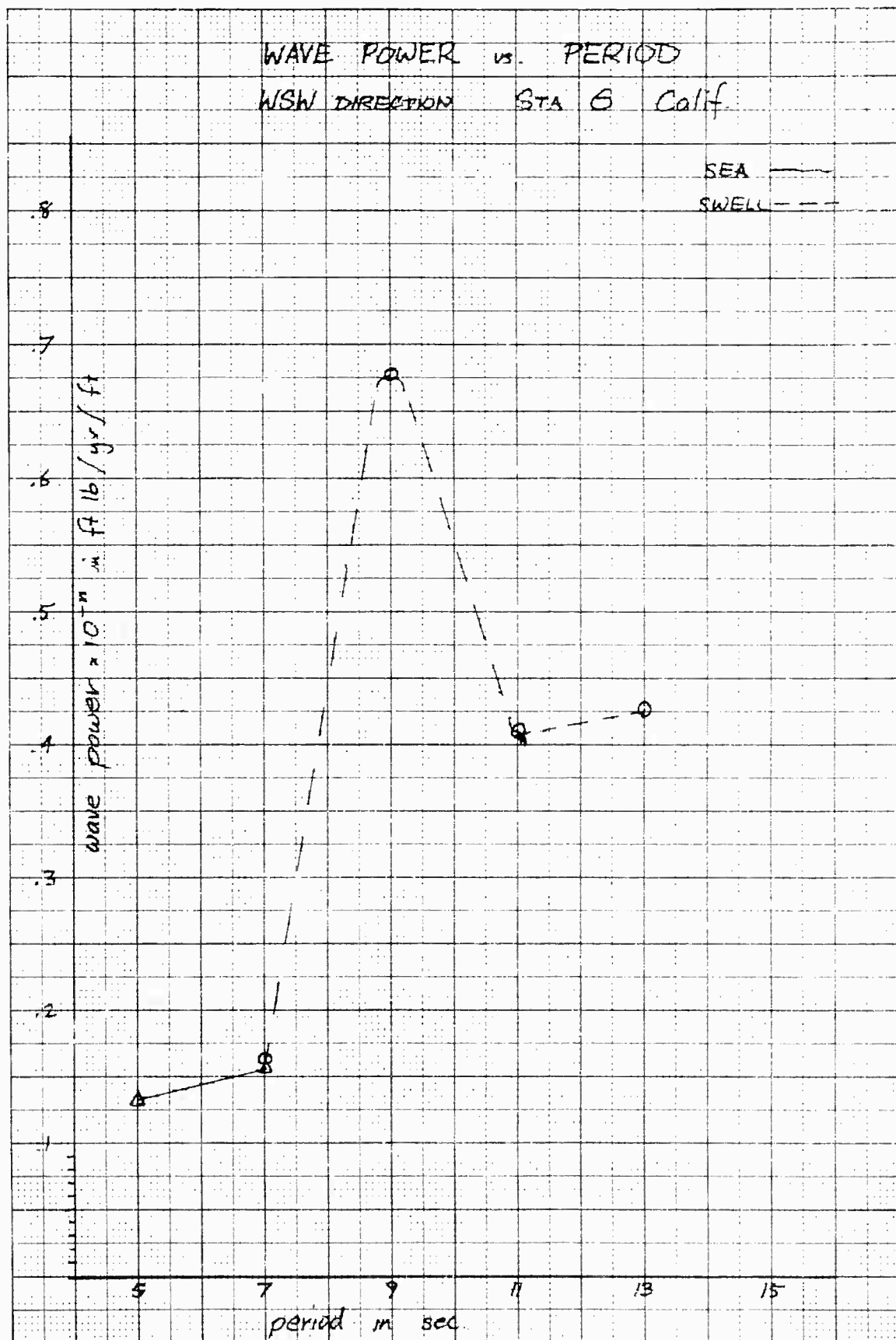
K&S 10 X 10 TO 1 1/2 INCH 46 1323
 MADE IN U.S.A.
 MODEL 4-15000



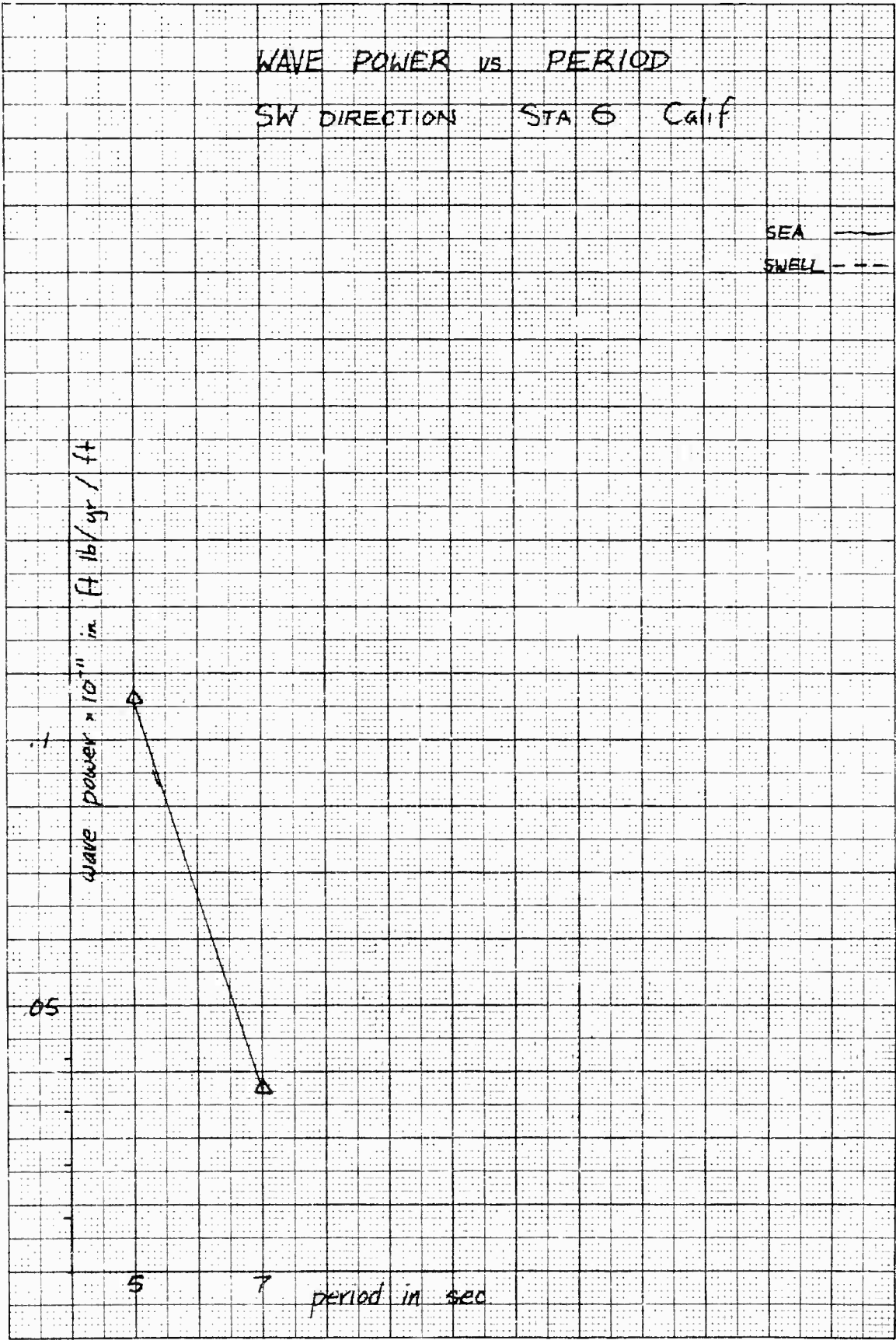
K&E 10 X 10 TO 1/2 INCH 46 1323
7 1/2 INCHES 46 1323
K&E 10 X 10 TO 1/2 INCH 46 1323



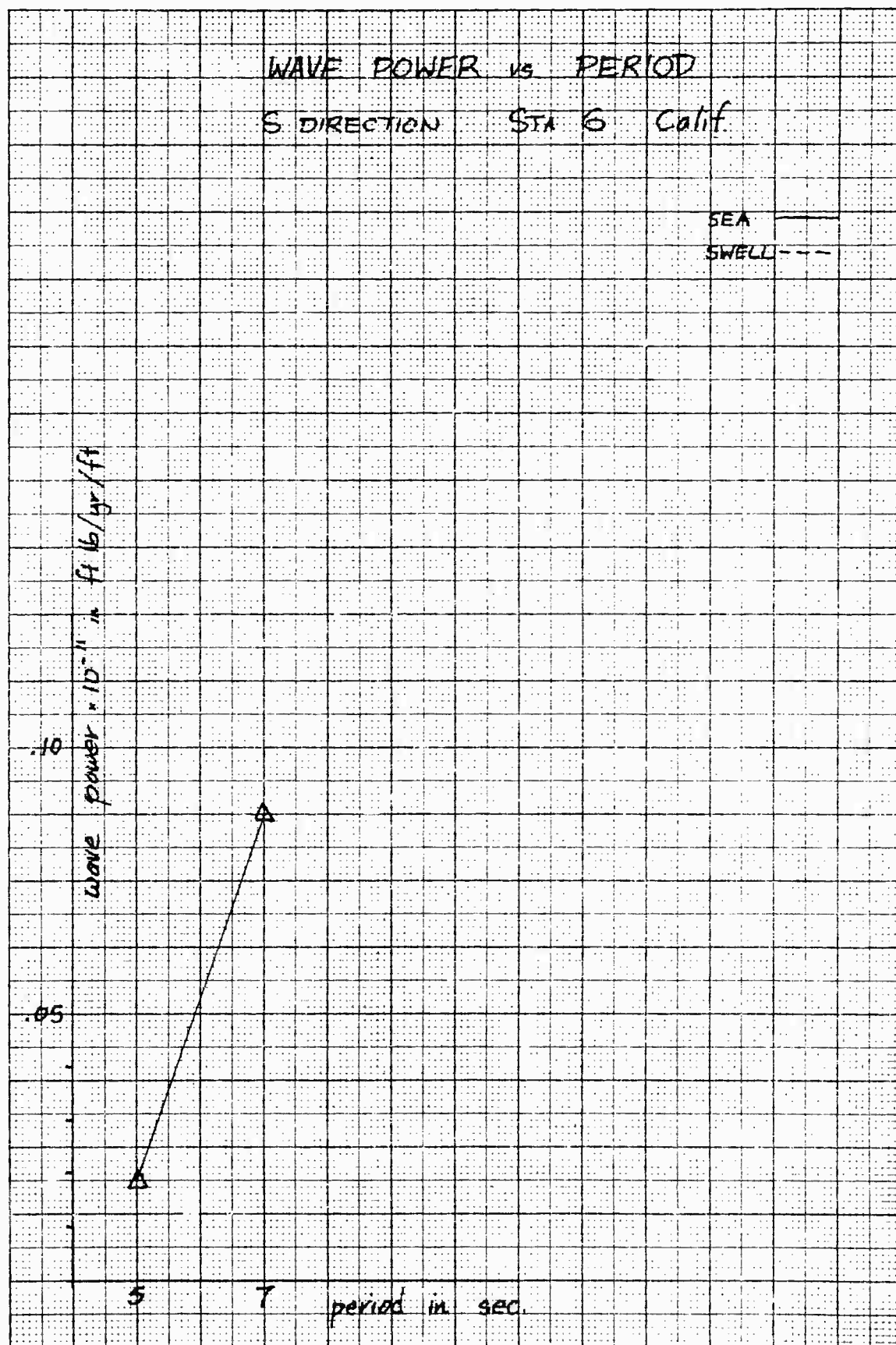
K&E 10 X 10 TO 1 1/2 INCH 46 1323
 K&E 10 X 10 TO 1 1/2 INCH 46 1323
 K&E 10 X 10 TO 1 1/2 INCH 46 1323



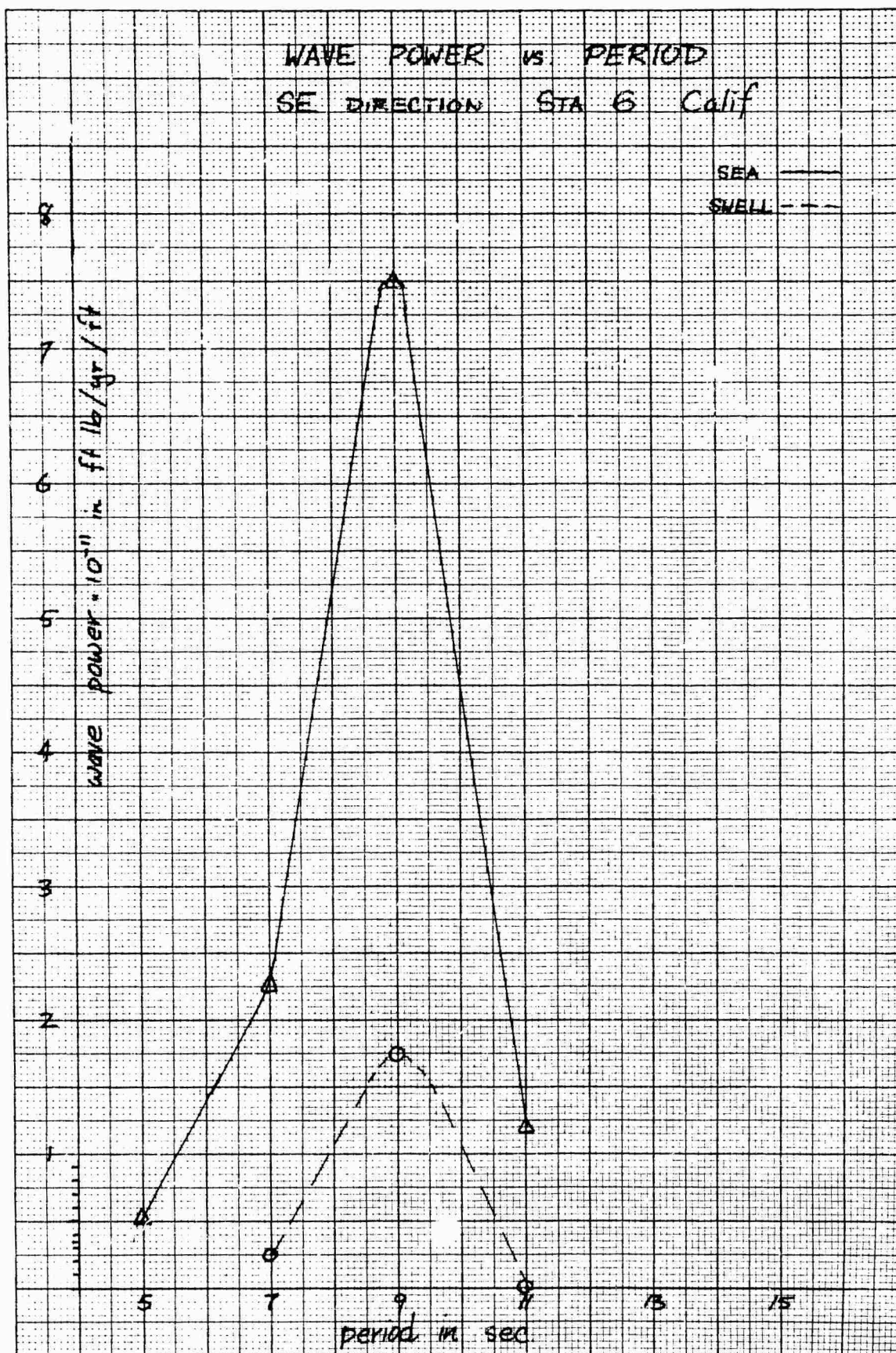
REF 10 X 10 TO 1 1/2 INCH 46 1323
K&E
Y IN PACE
KUFFEL & ESNER CO
CHICAGO, ILL. U.S.A.



K&E 10 X 10 TO 1 1/2 INCH 46 1323
 NEUFELIA 55-19 CG



K&E 10 X 10 TO 1 1/2 INCH 46 1323
MADE IN U.S.A.
KEUFFEL & ESSER CO.

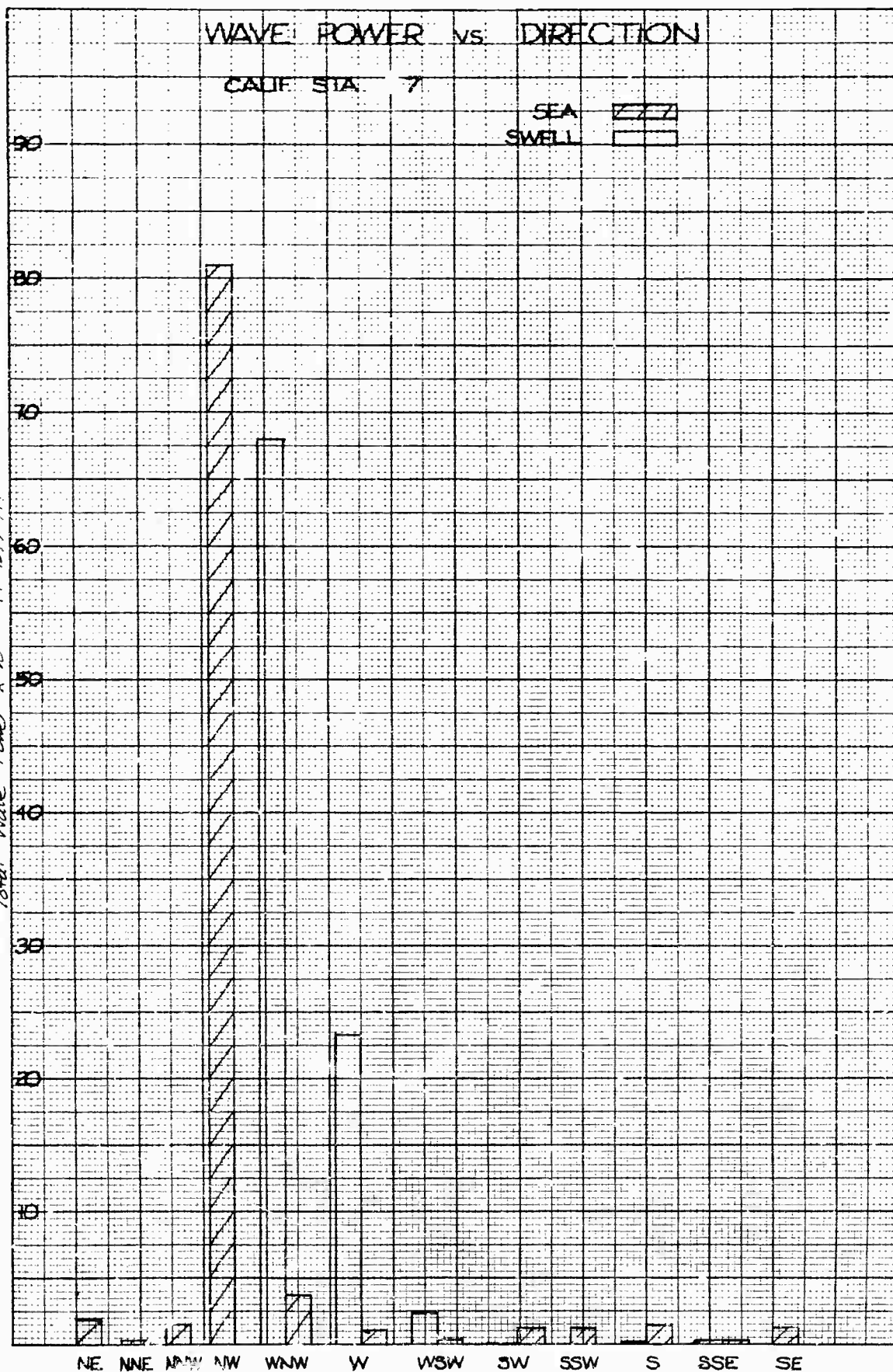


STATION 7 - CALIFORNIA COAST

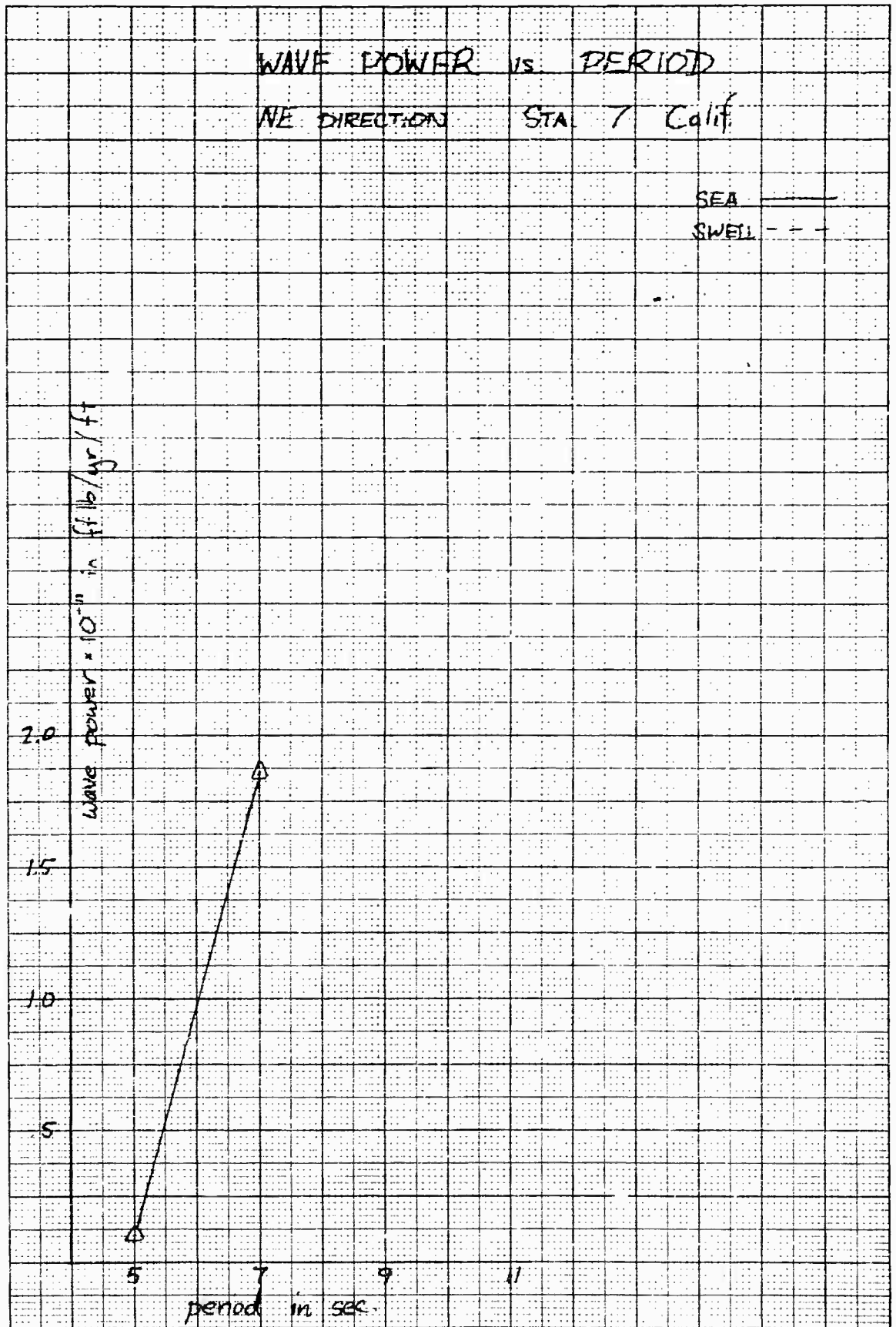
Lat. 33.5°N , Long. 119.5°W

10 X 10 TO 1/2 INCH 46 1323
 1 X 10 IN 10.5
 KUTZEL & EBER CO.

Total Wave Power x 10⁻¹¹ ft-lb/sec/ft

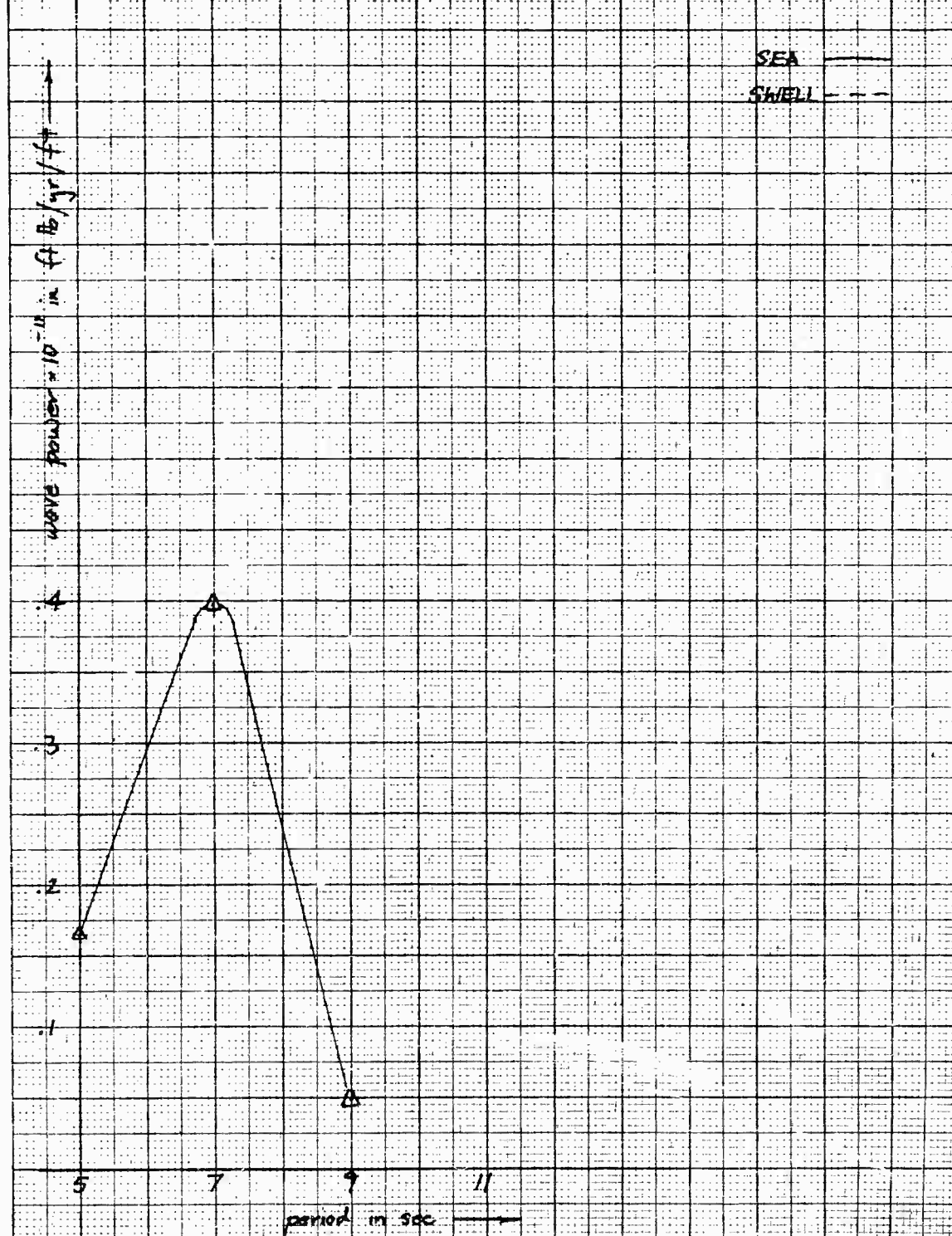


K&E 10 X 10 TO 1/2 INCH 46 1323
 MADE IN U.S.A.
 REUPPEL & SONS CO.



WAVE POWER vs. PERIOD

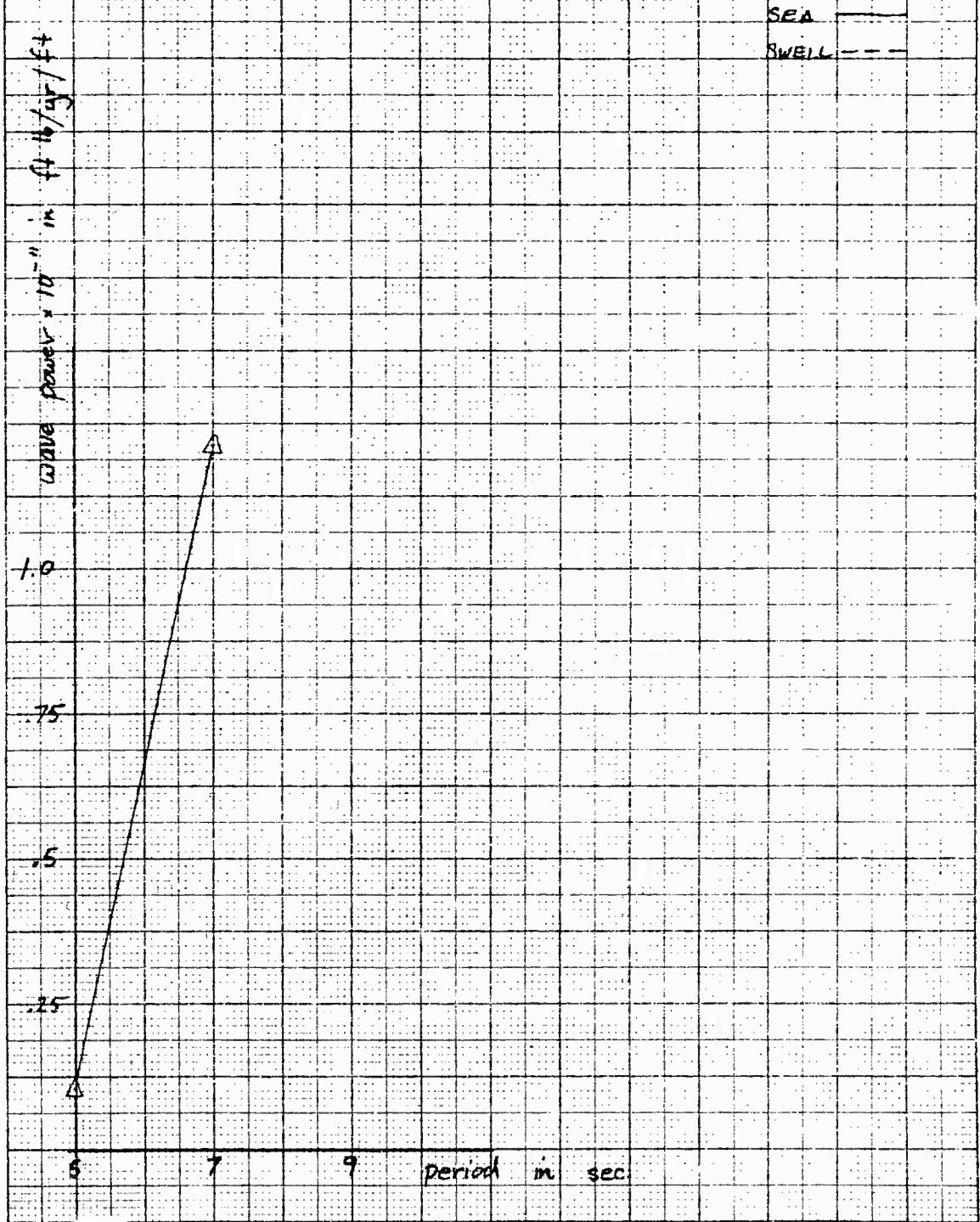
N DIRECTION STA 7 Calif.



K&E 10 X 10 TO 1/2 INCH 46 1323
K&E 10 X 10 TO 1/2 INCH 46 1323
K&E 10 X 10 TO 1/2 INCH 46 1323

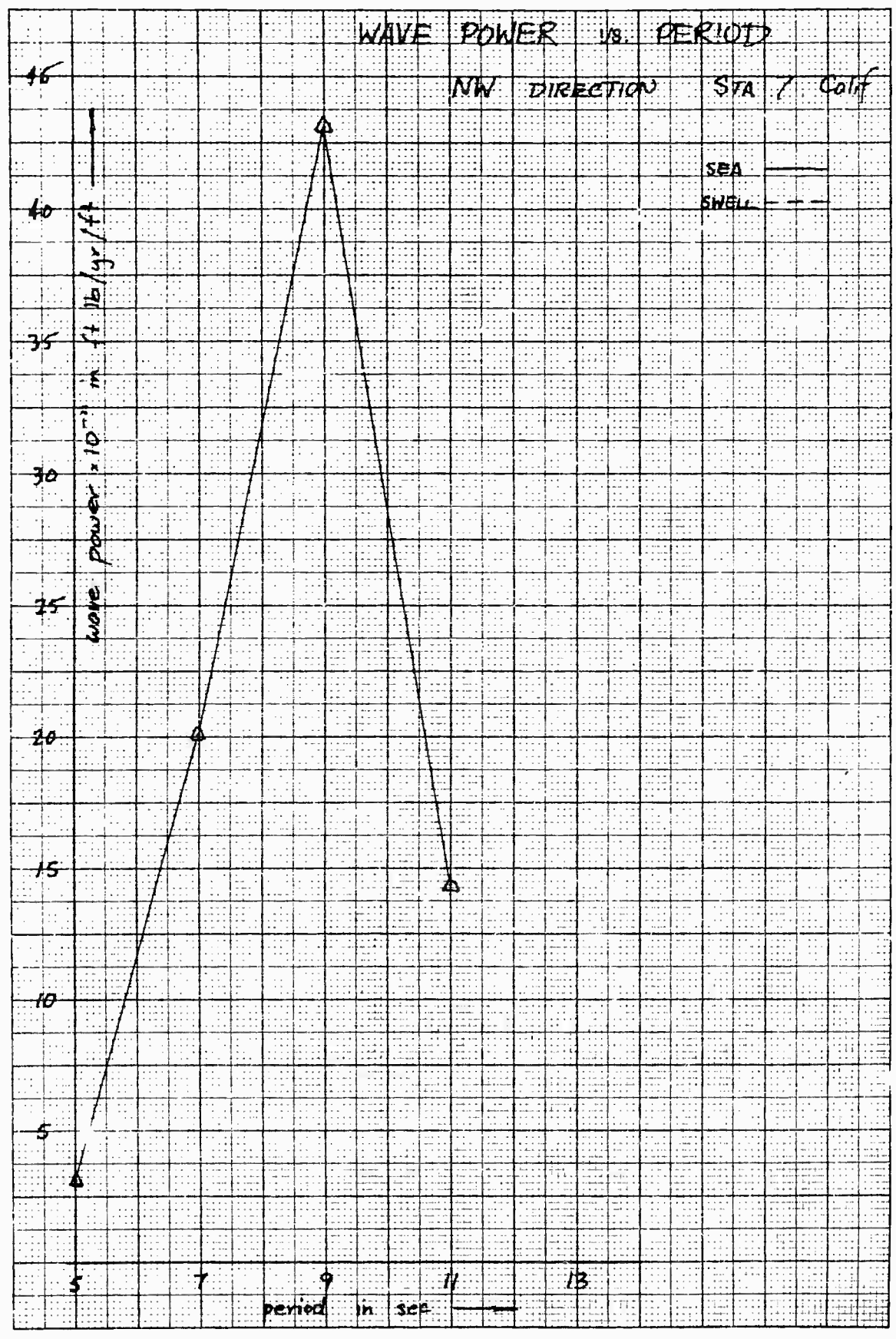
WAVE POWER VS PERIOD

NNW DIRECTION STA 7 Calif

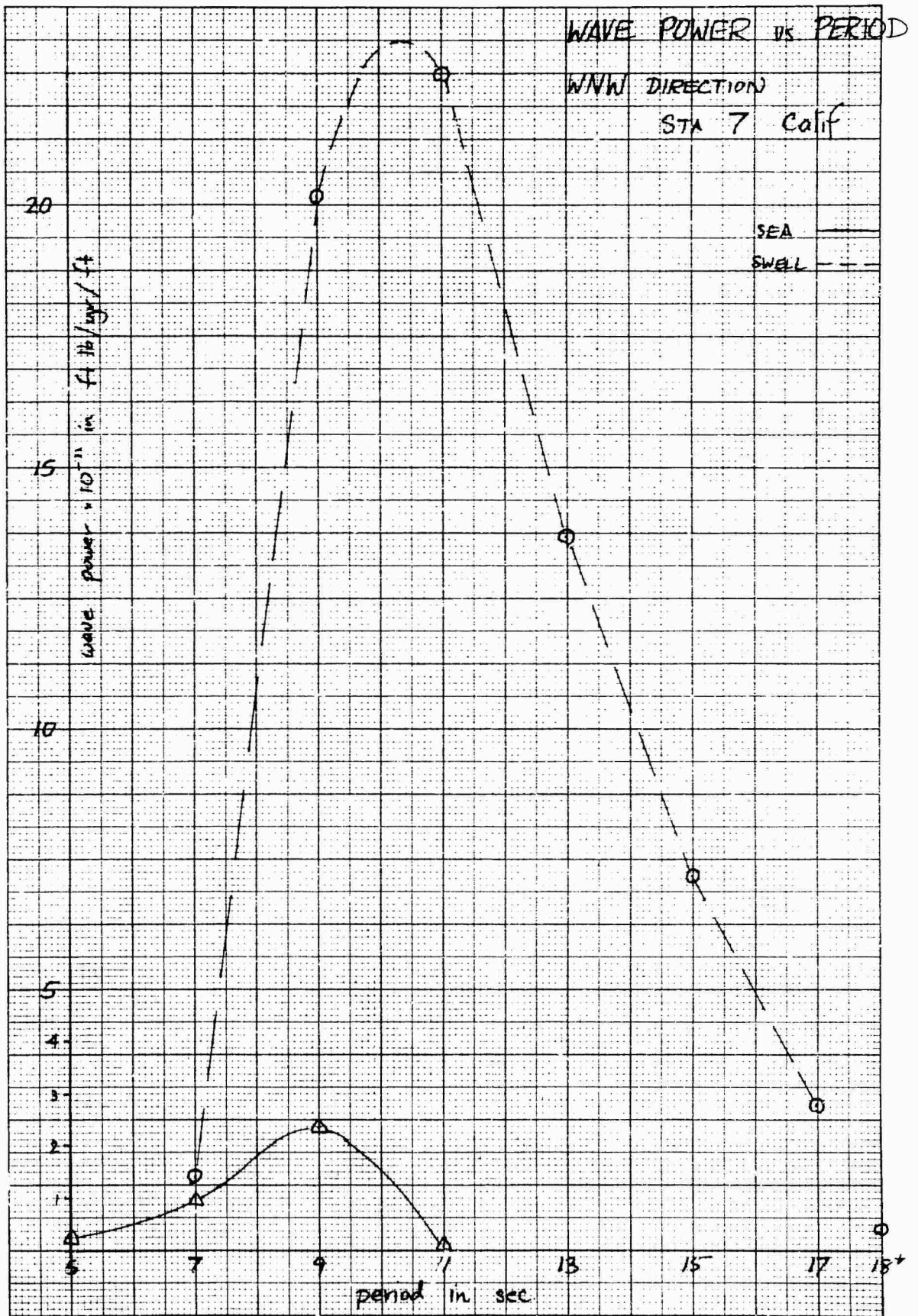


KE 10 X 10 TO 1 1/2 INCH 46 1323
MADE IN U.S.A.
ACUFFEL & ASSOCIATES

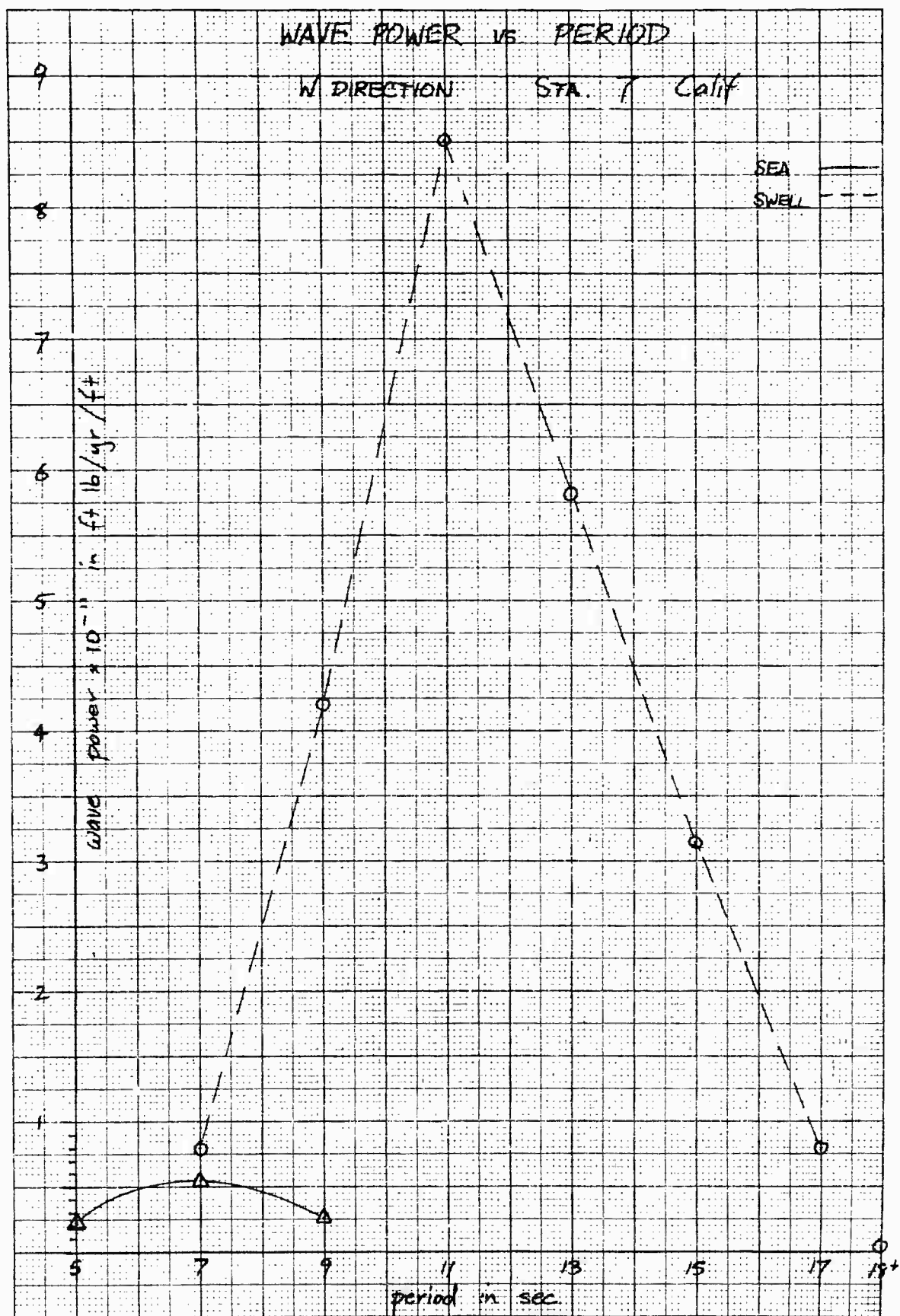
K&S 12 X 10 TO 1 1/2 INCH 46 1323
MADE IN U.S.A.
RESERVED PATENT CO.

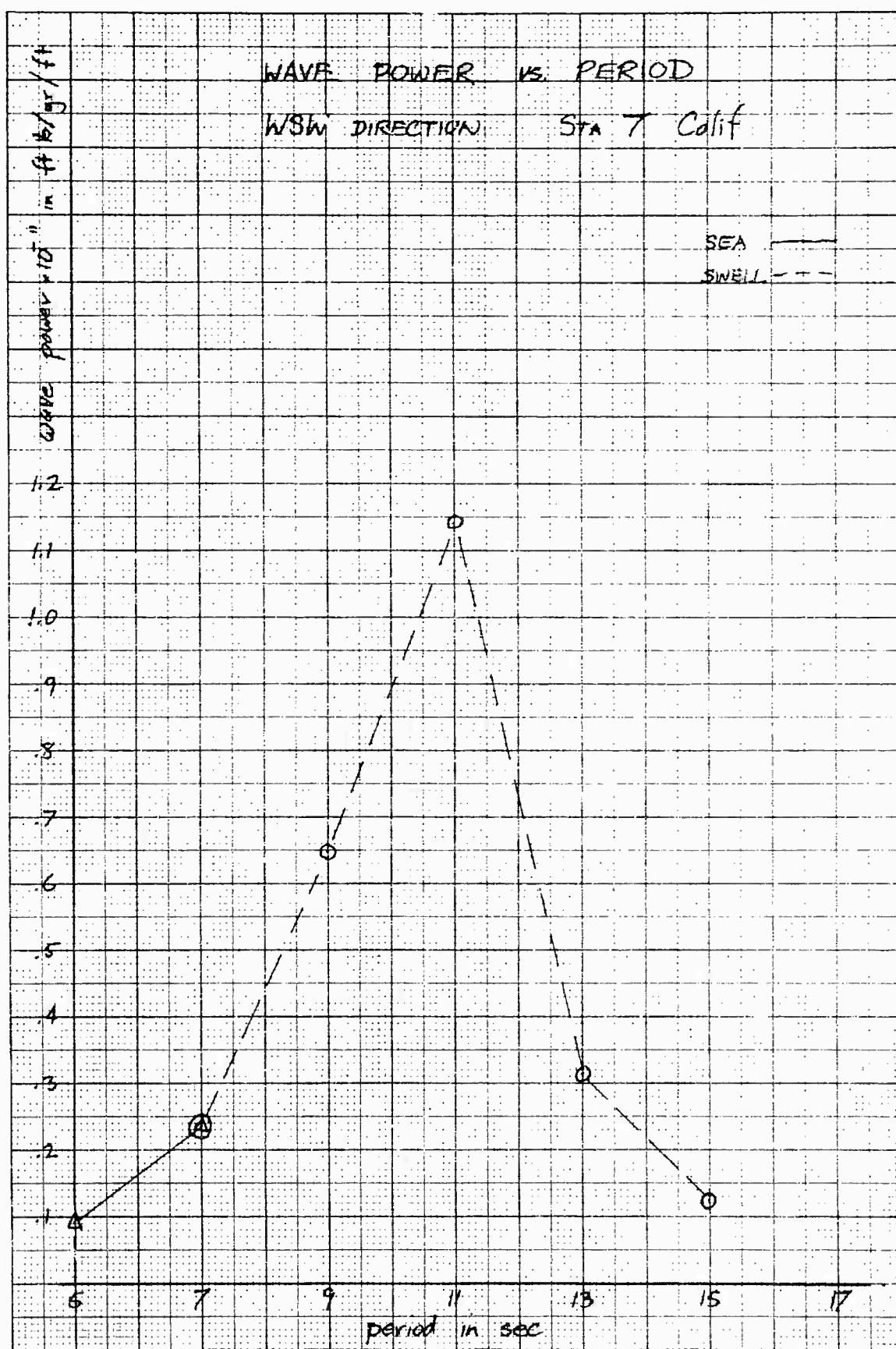


K&E 10 X 10 TO 1 1/2 INCH 46 1323
 MADE IN U.S.A.
 NEUFFEL & ESSER CO.

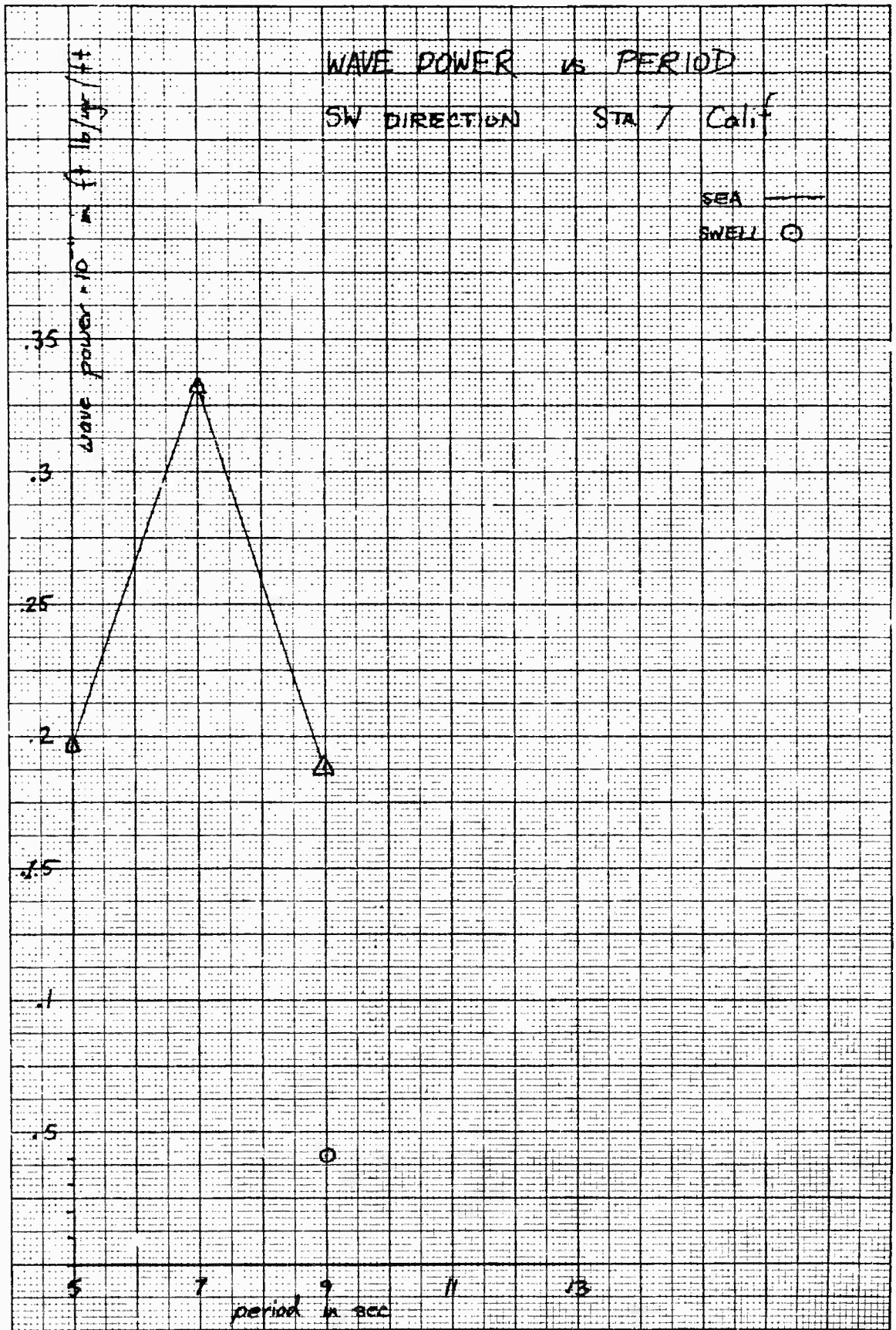


K-2 10 X 10 TO 1/2 INCH 46 1323
 KALUFILL & LUTHER CO.

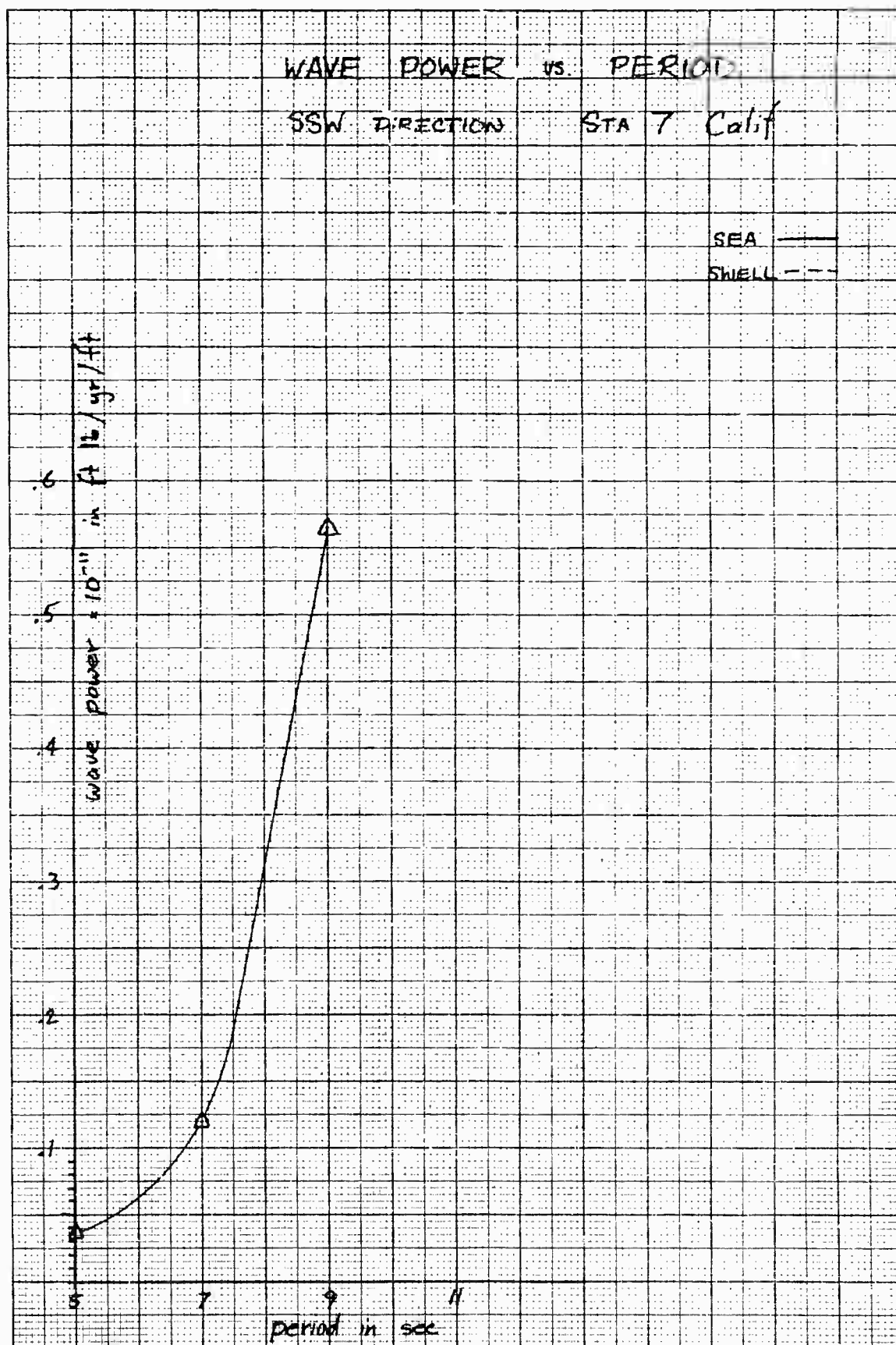




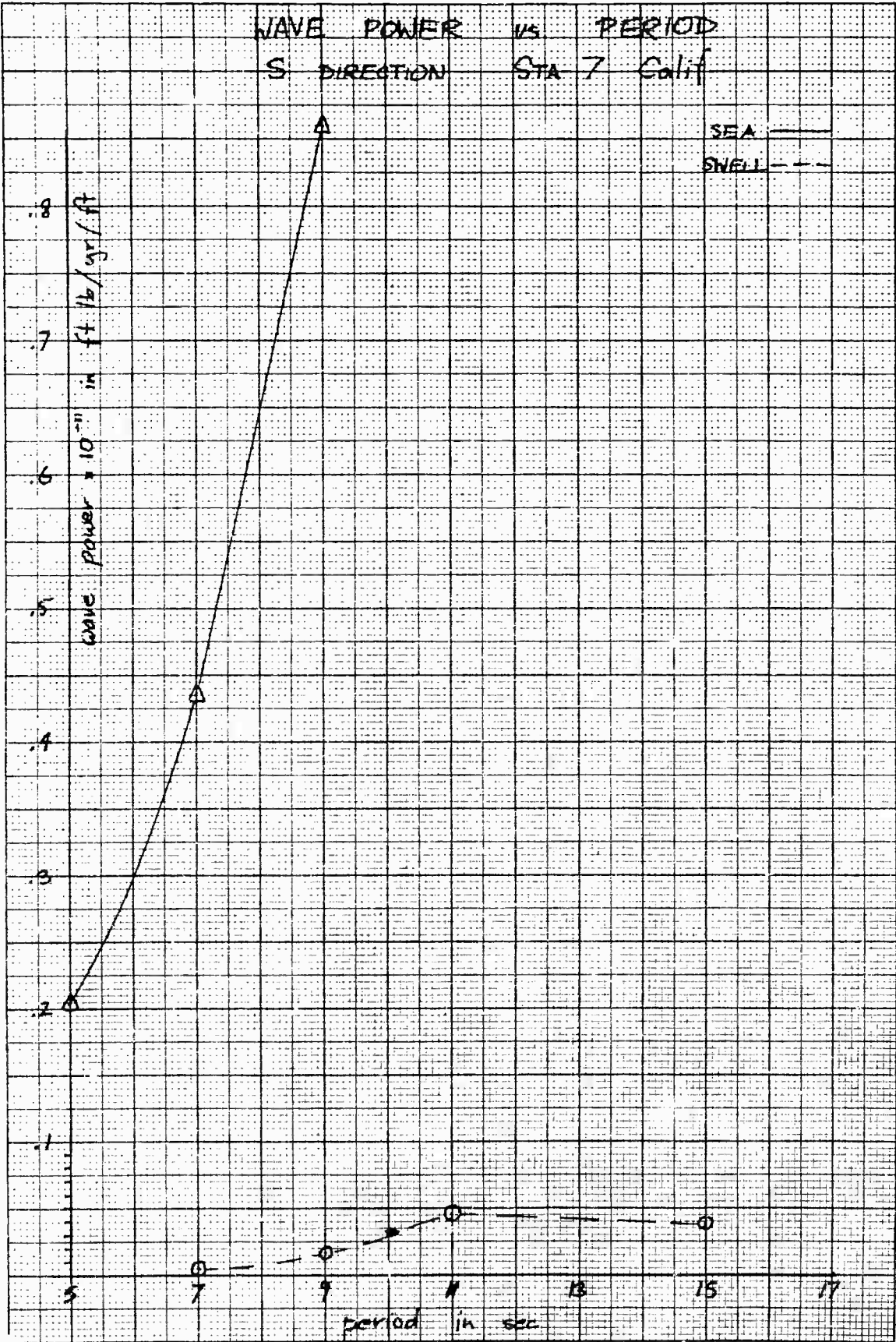
K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.

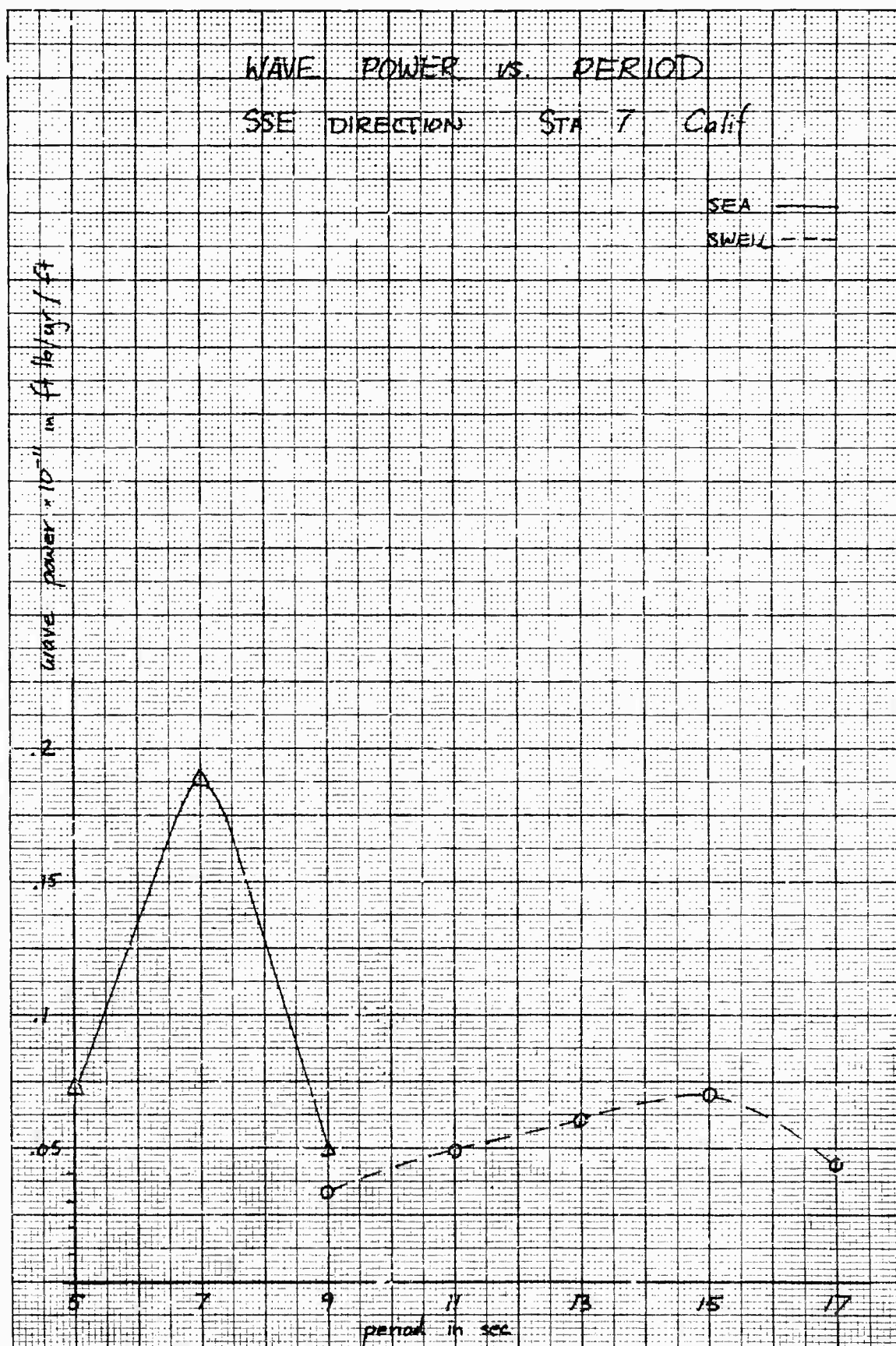


NO 10 X 10 TO 12 INCH 46 1323
 A-76
 KNUFTEL & PESSER CO.



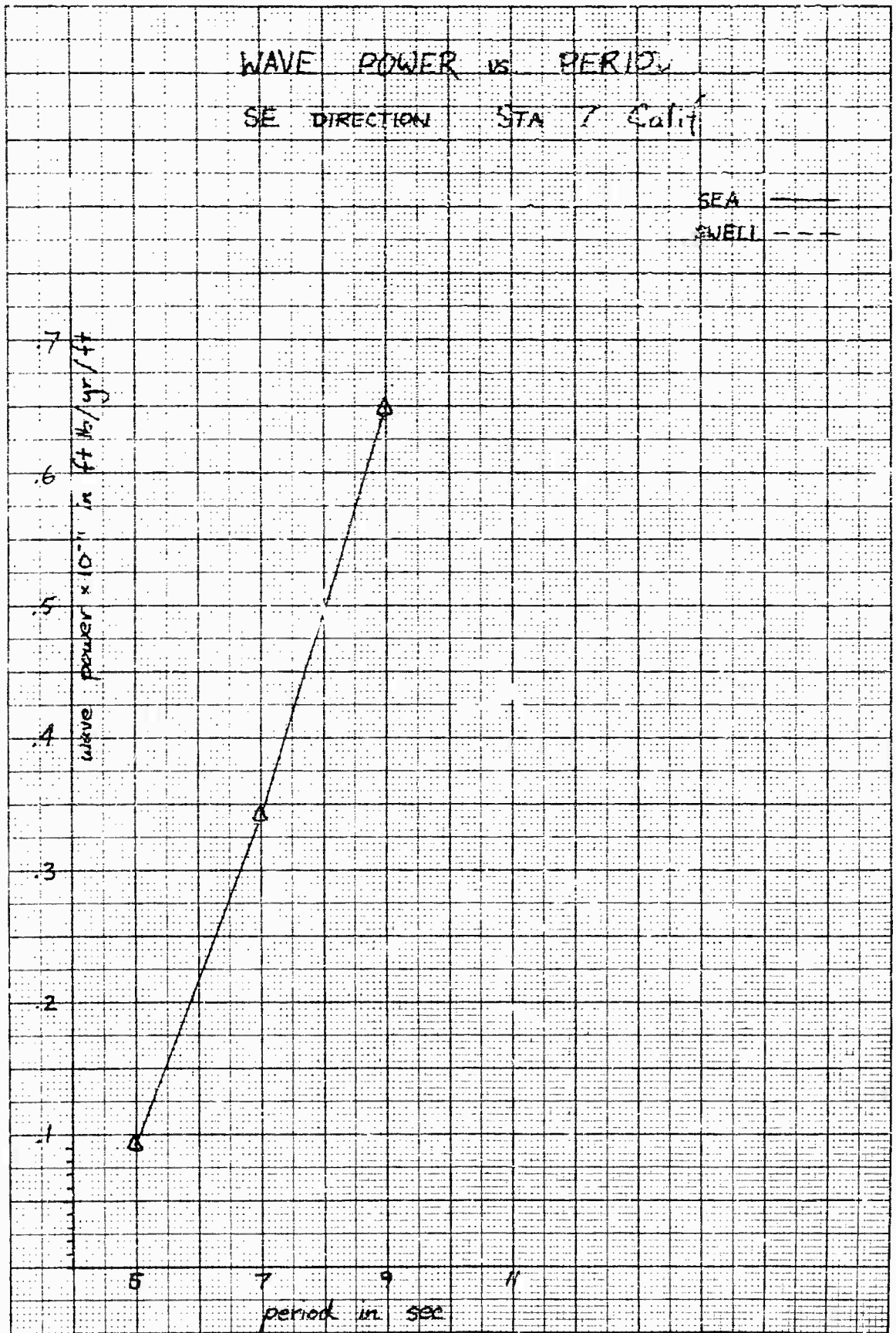
REF 10 X 10 TO 1 1/2 INCH 46 1323
JAN 1964 INCH 1 1/2 INCH 1 1/2 INCH
NEUTRAL 1 1/2 INCH 1 1/2 INCH





K&E 10 X 10 TO 1/2 INCH 46 1323
X 10 INCHES
KRIFFEL & CESER CO.

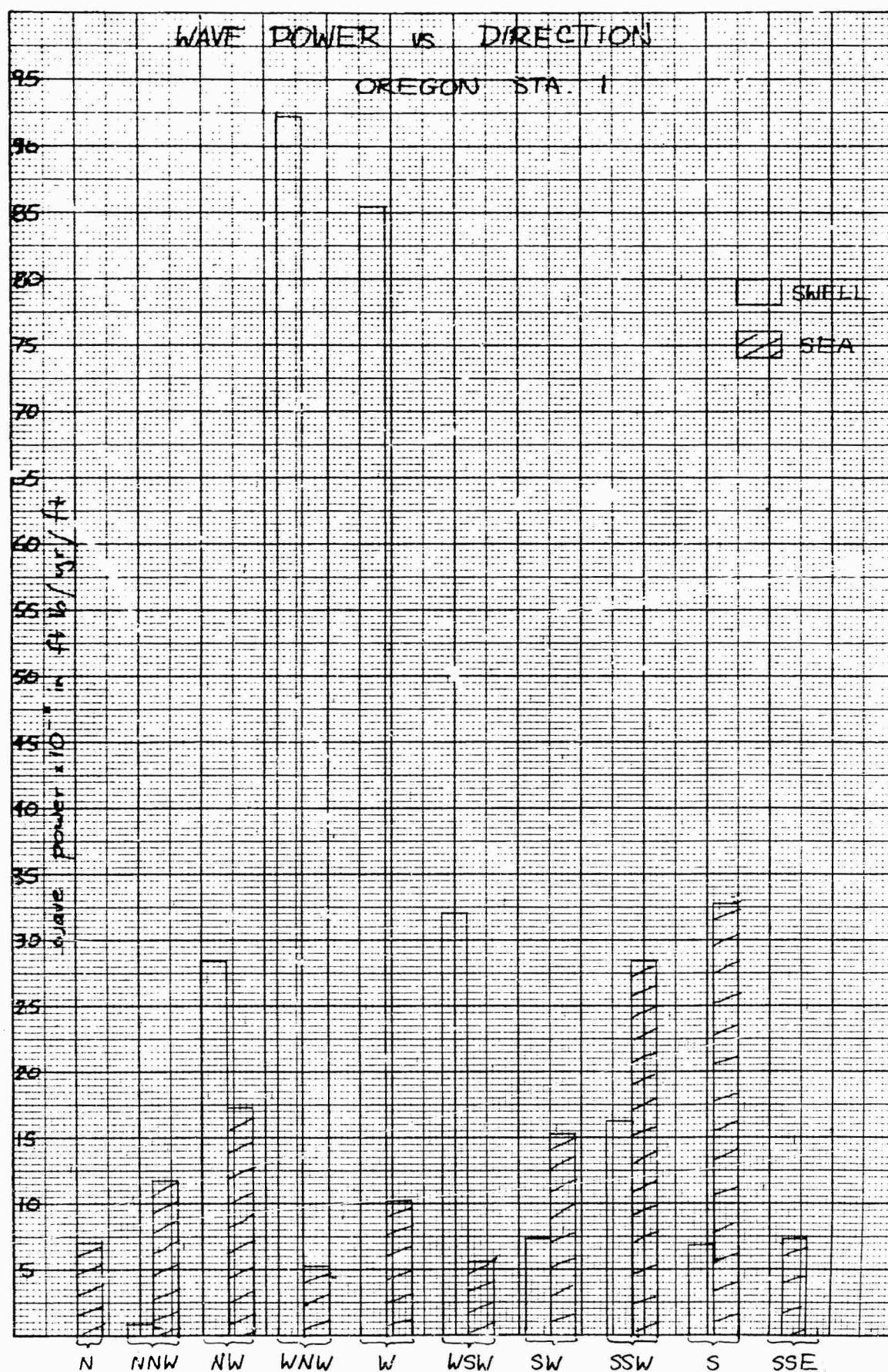
K&S 10 x 10 TO 1/2 INCH 46 1323
 REPTILES & BIRDS



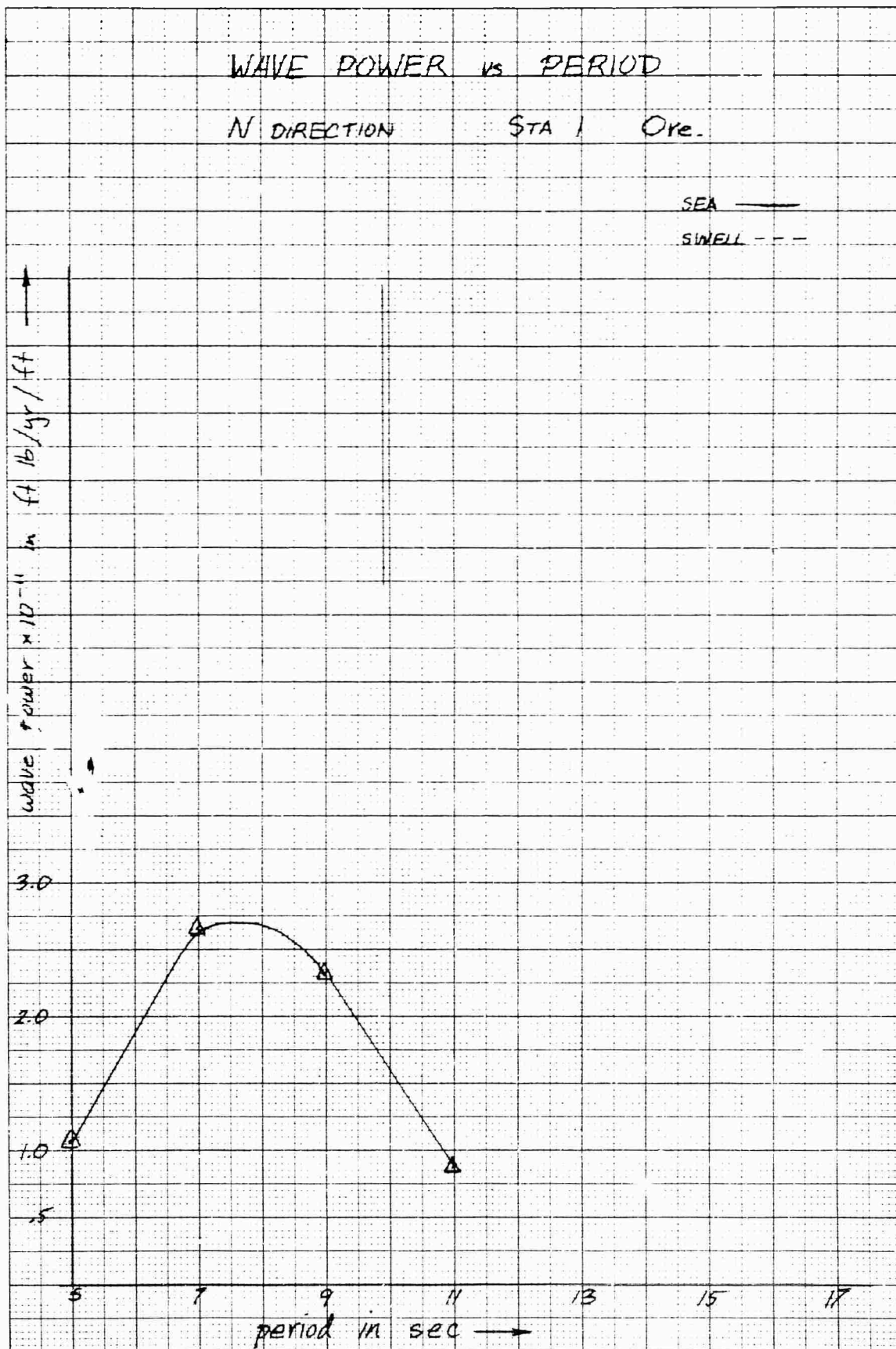
STATION 1 - OREGON COAST

Lat. $44^{\circ} 40'N$, Long. $124^{\circ} 50'W$

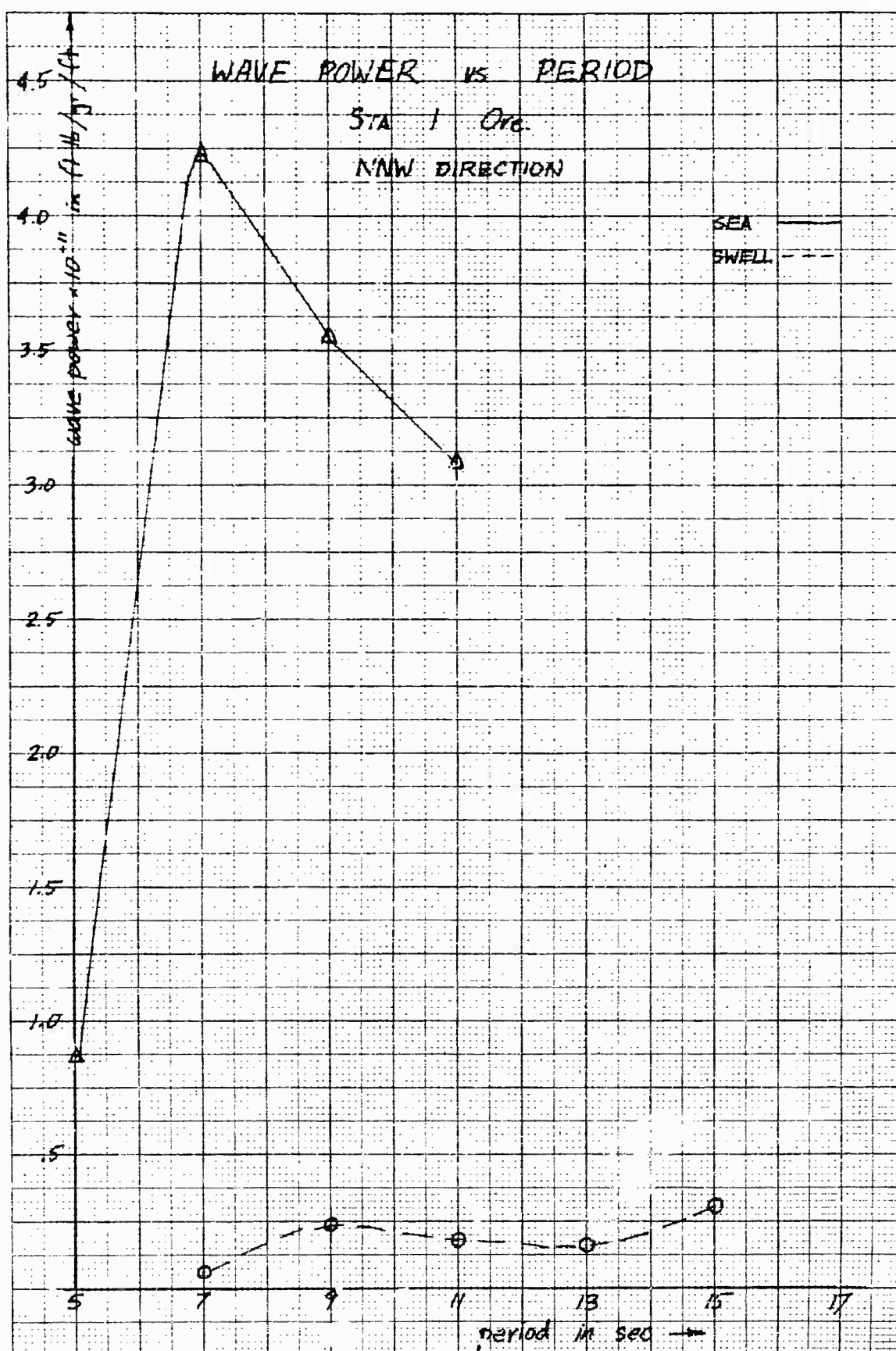
14-2 10 x 10 TO 1/2 INCH 46 1323
 7 x 10 INCH
 KEUFFEL & ESSER CO.

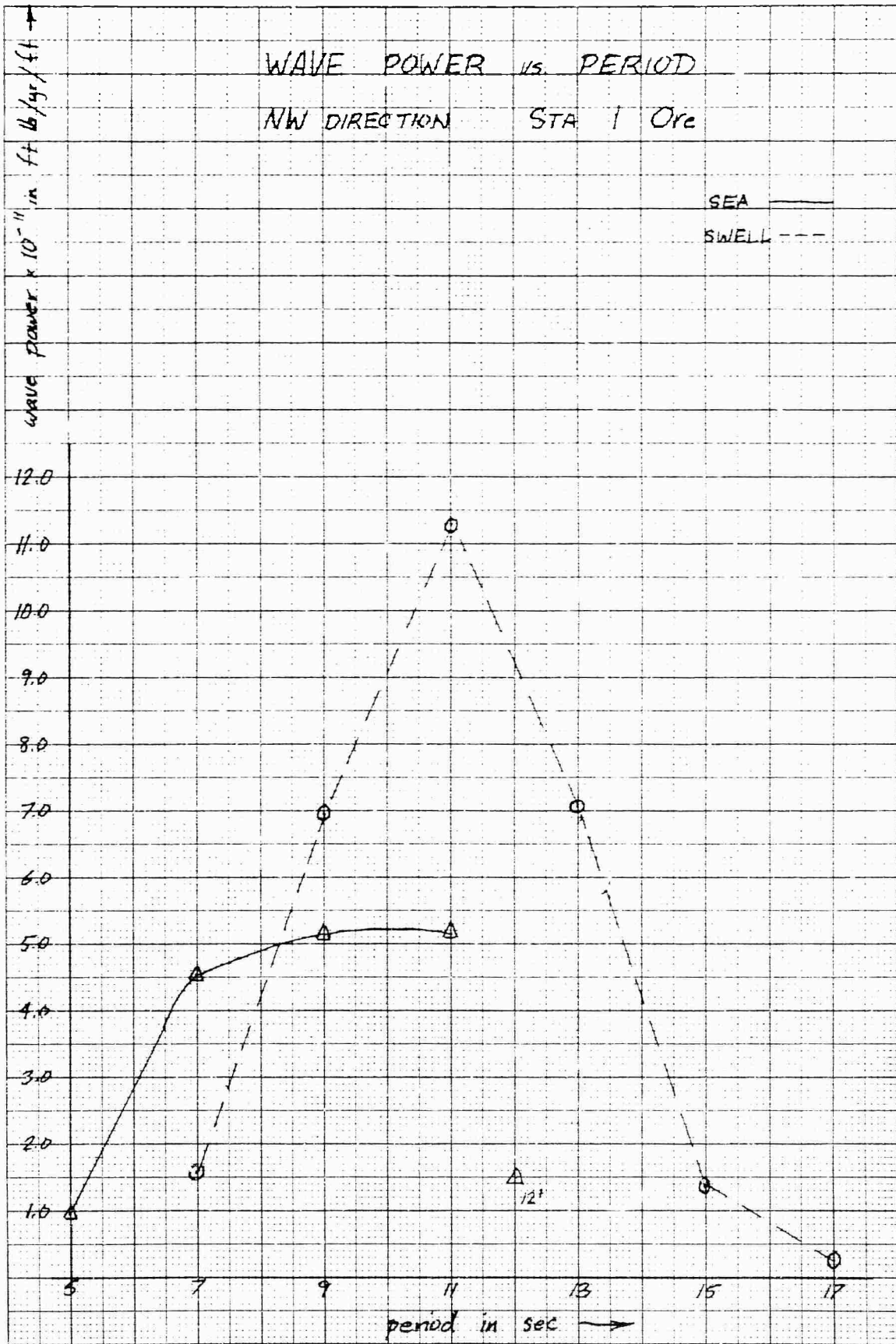


KE 10 X 10 TO 10 INCH 46 1323
AN INCH 46 1323
PROPERTY OF U.S. NAVY

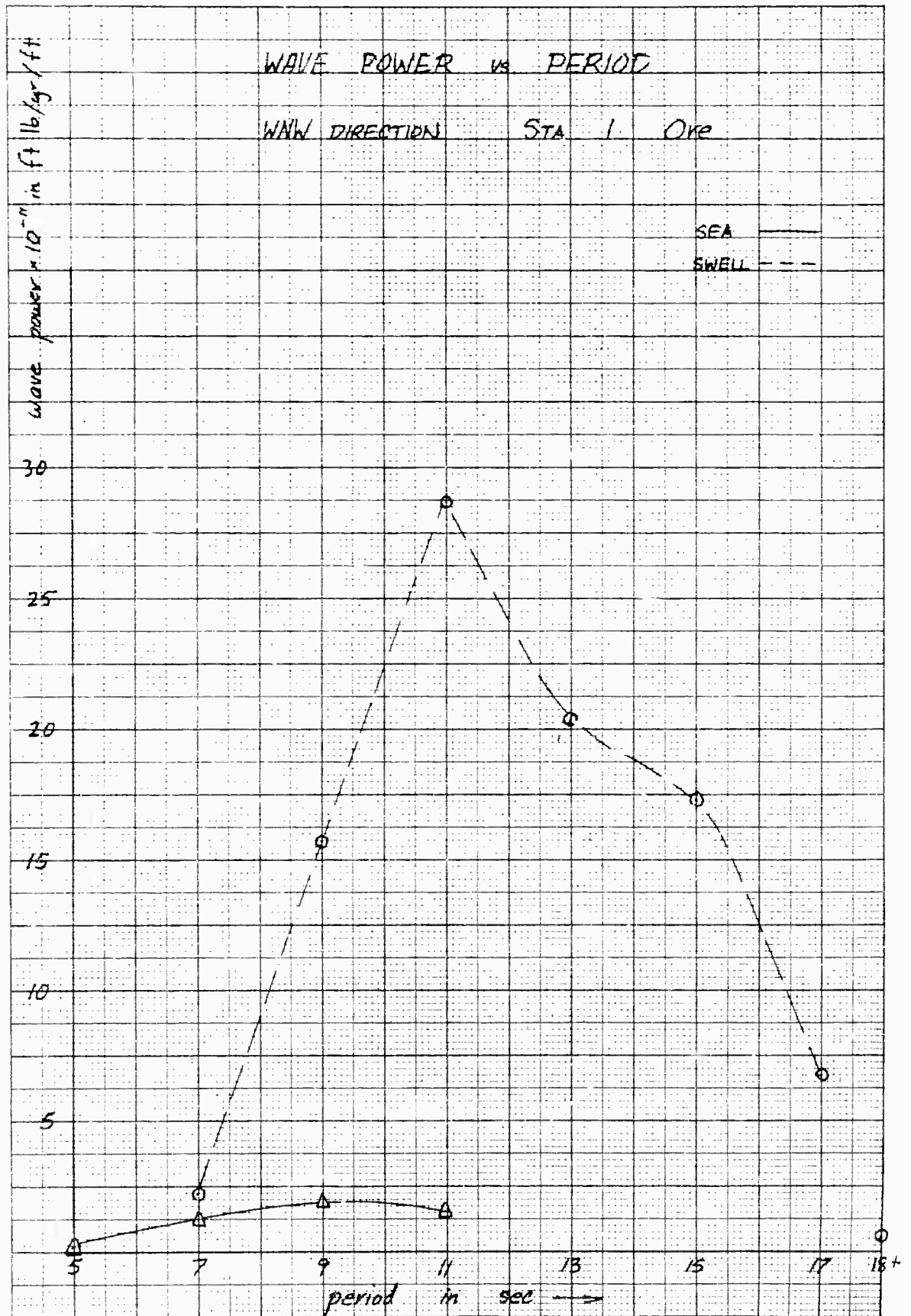


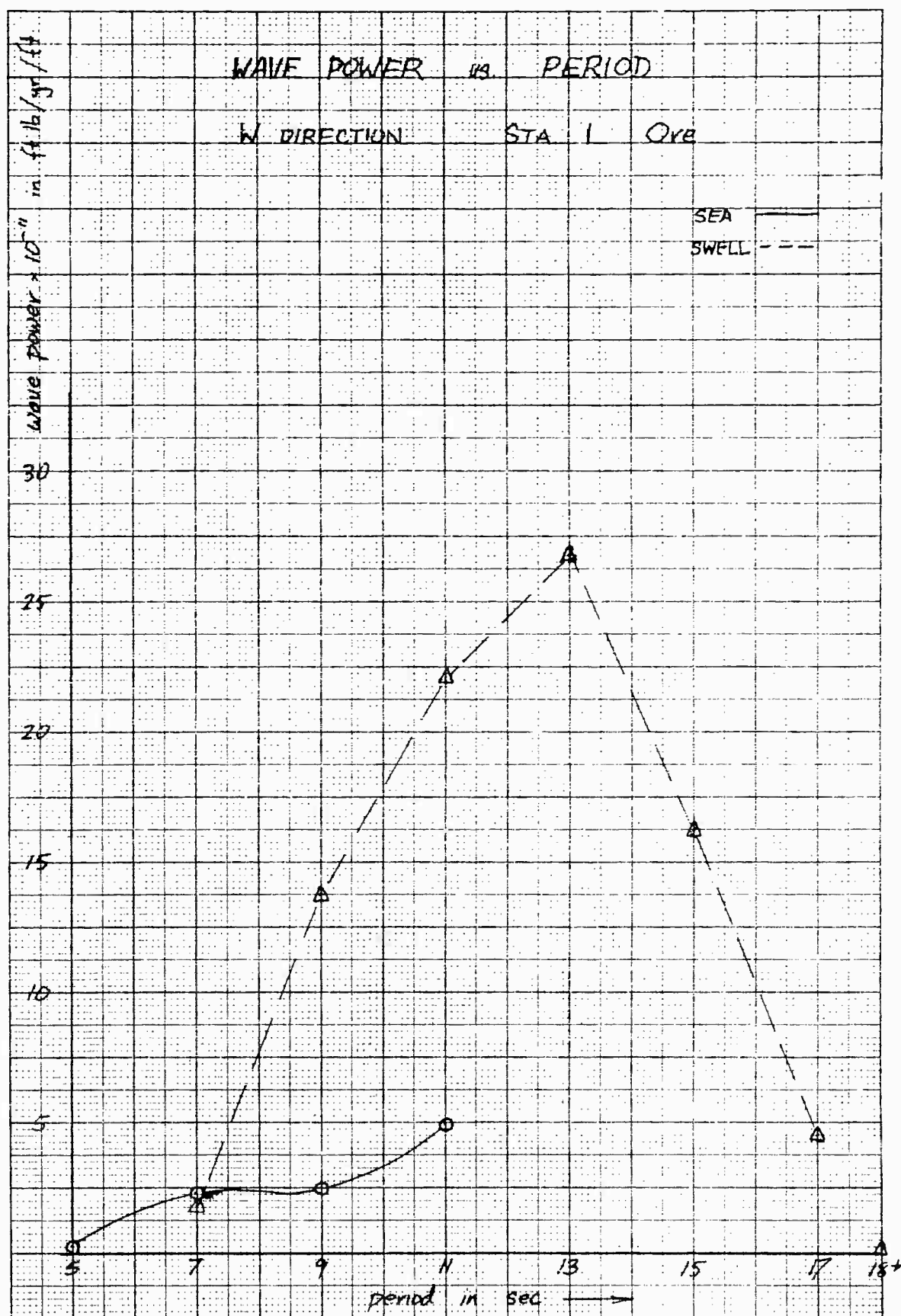
FORM 10 X 10 TO 1/2 INCH 46 1323
 U.S. GOVERNMENT PRINTING OFFICE



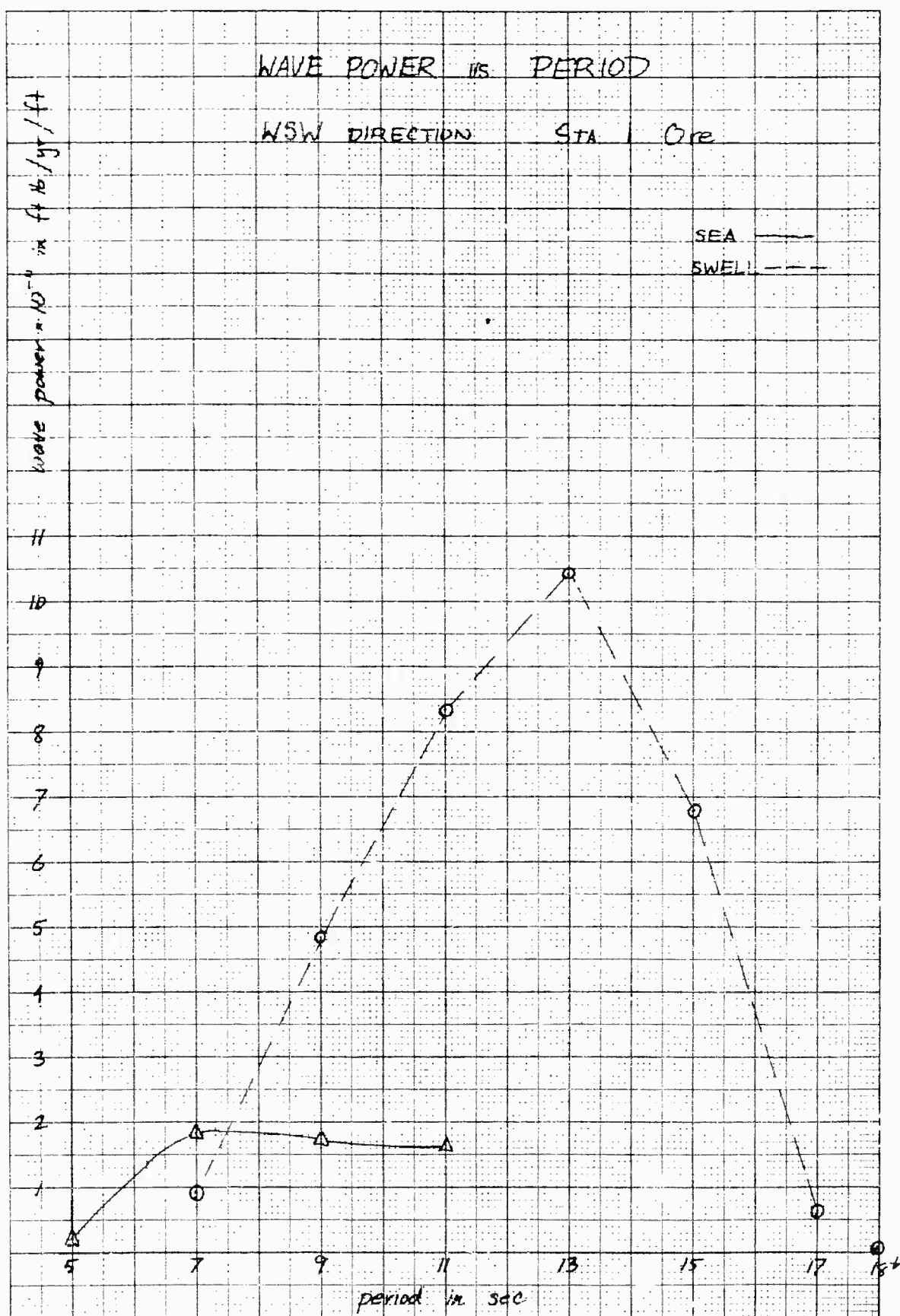


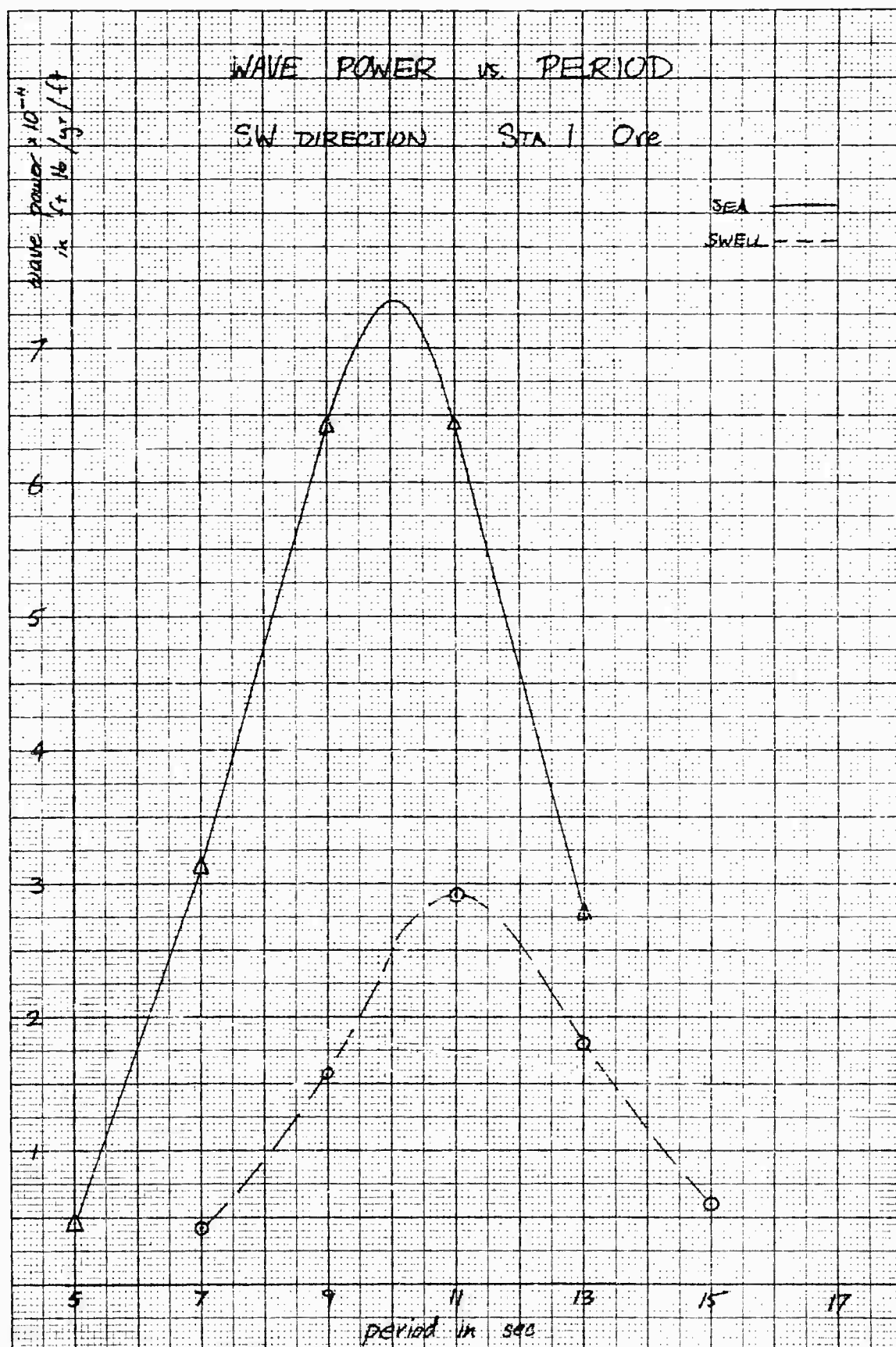
10 X 10 TO 1 1/2 INCH 46 1323
 PEOPLE'S REPUBLIC OF CHINA



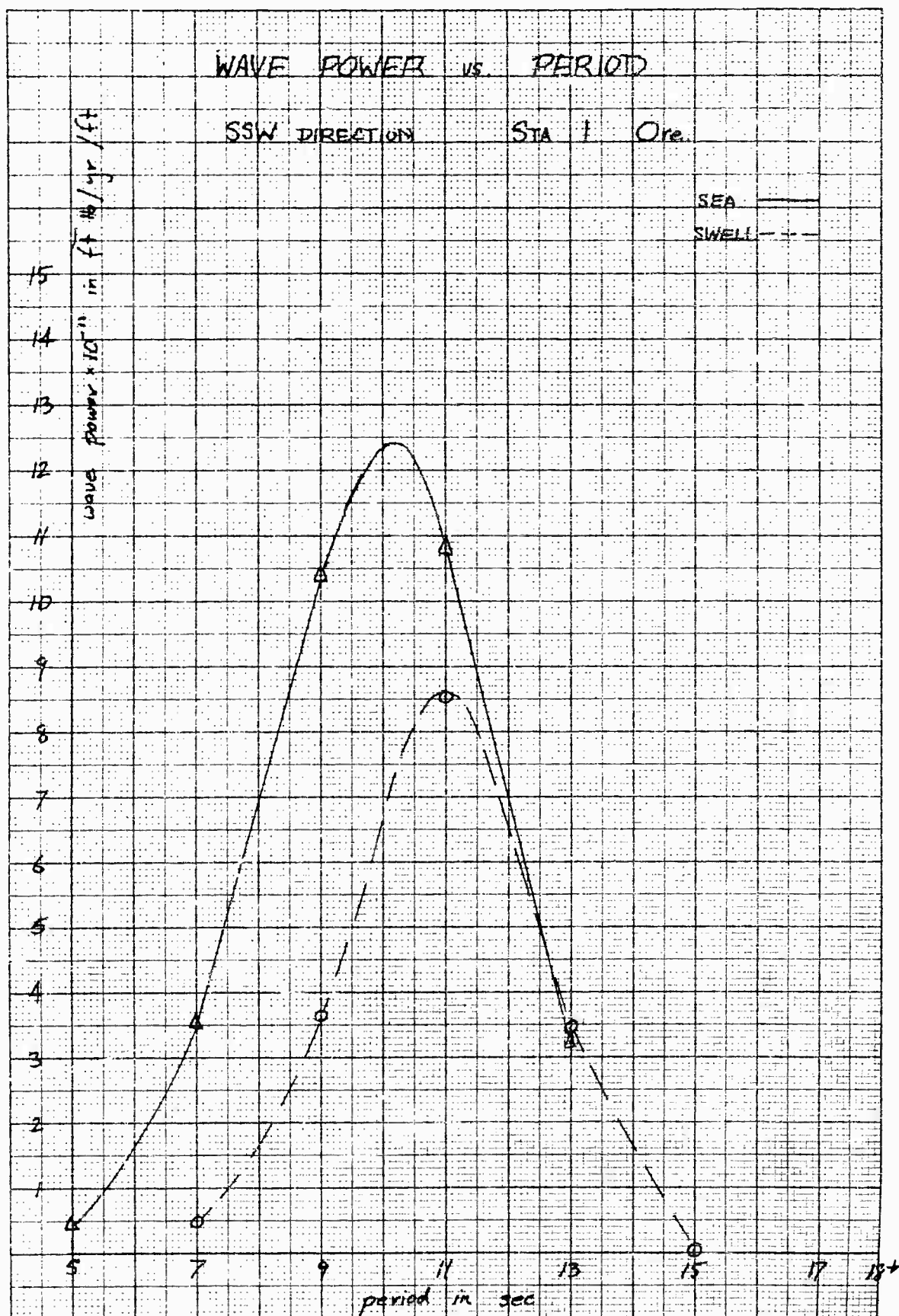


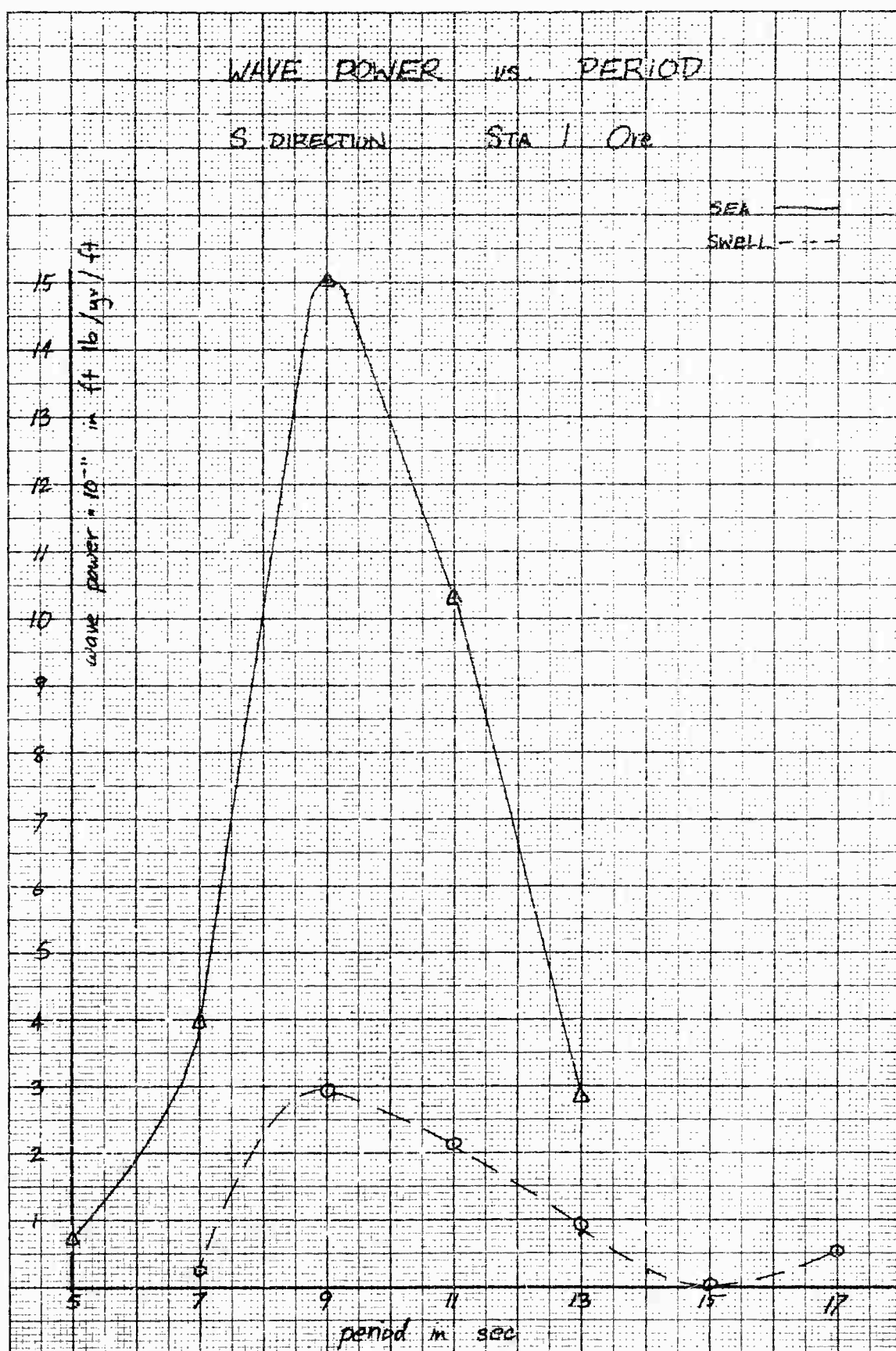
12 10 X 10 TO 1 INCH 46 1323
 12 10 X 10 TO 1 INCH 46 1323
 12 10 X 10 TO 1 INCH 46 1323



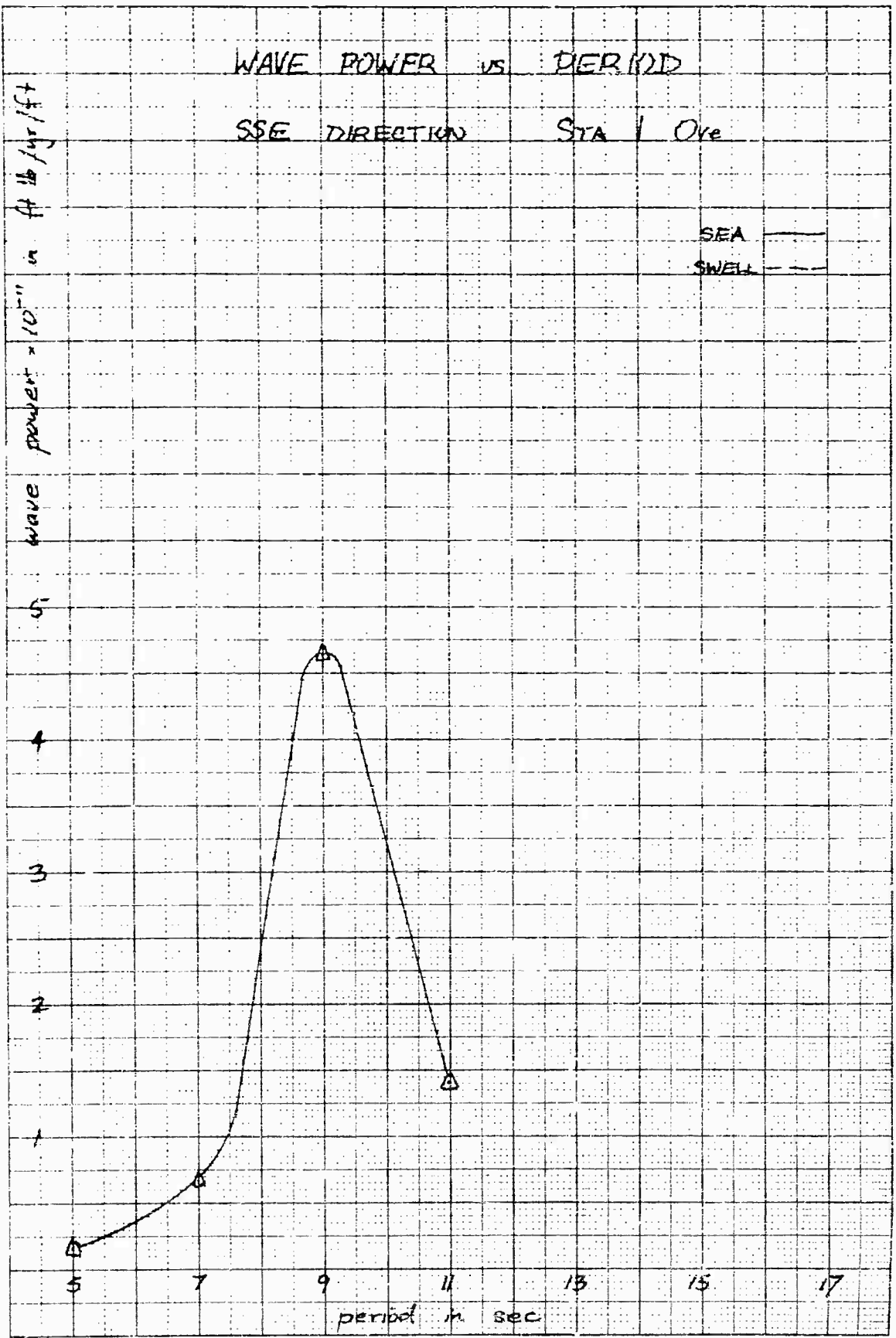


KE 10 x 10 to 1/2 inch 46 1323
 KEUFFEL & NAUGHTON CO. NEW YORK, N. Y.



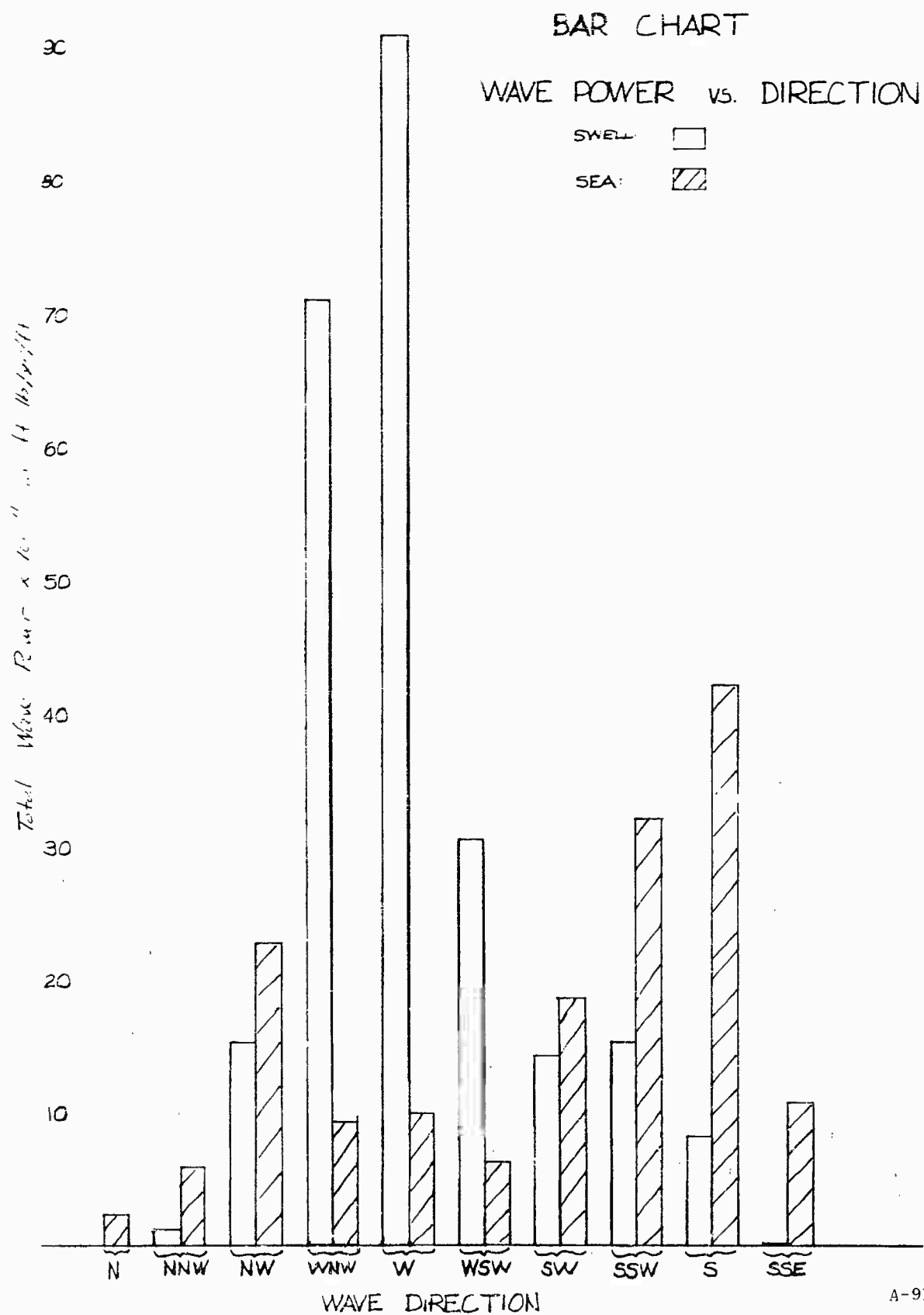


WAVE POWER vs PERIOD
SSE DIRECTION STA 1 Ore



STATION 2 - COLUMBIA RIVER MOUTH

Lat. $46^{\circ} 12' N$, Long. $124^{\circ} 30' W$

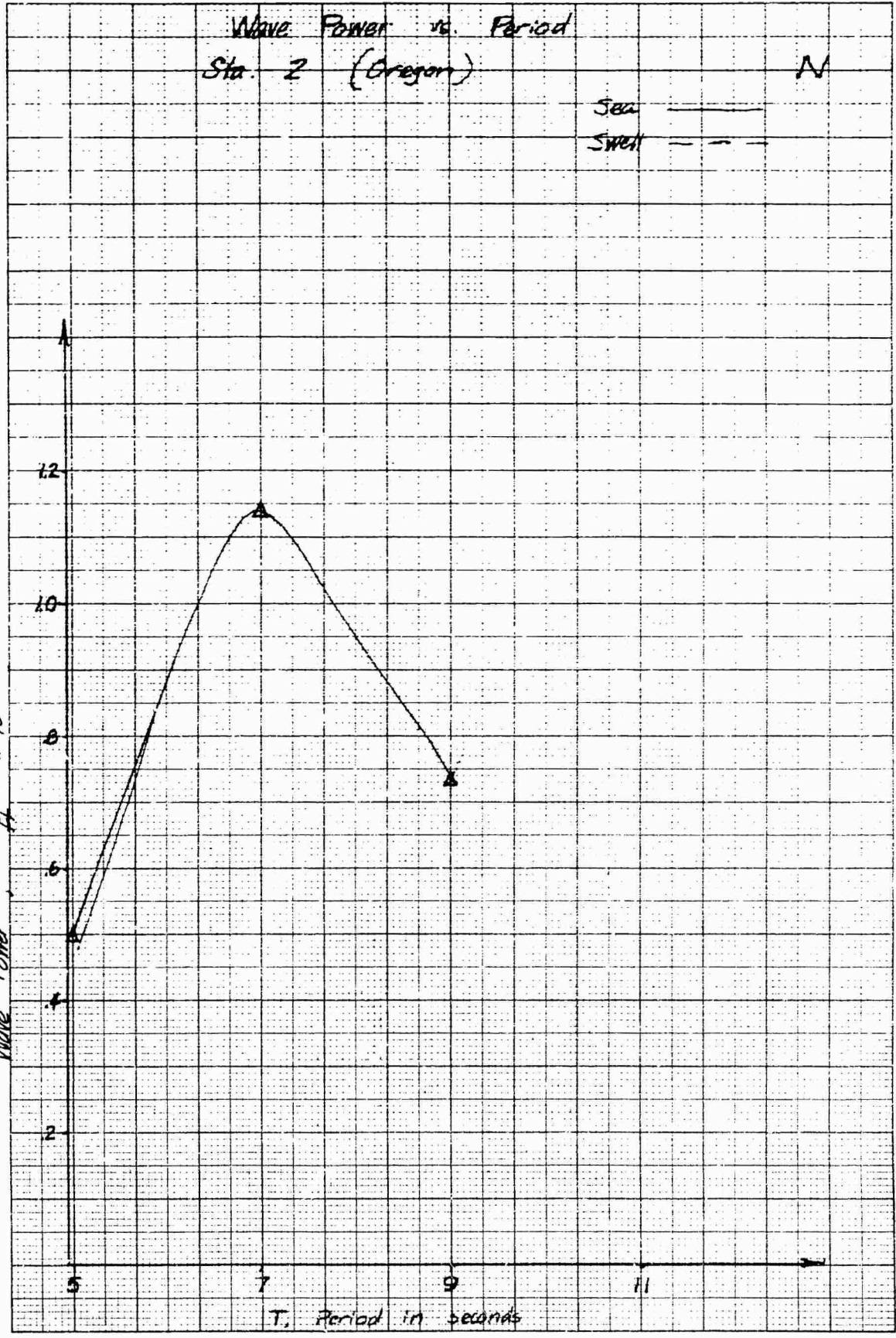


Wave Power vs. Period
Sta. 2 (Oregon)

Sea _____
Swell - - - -

N

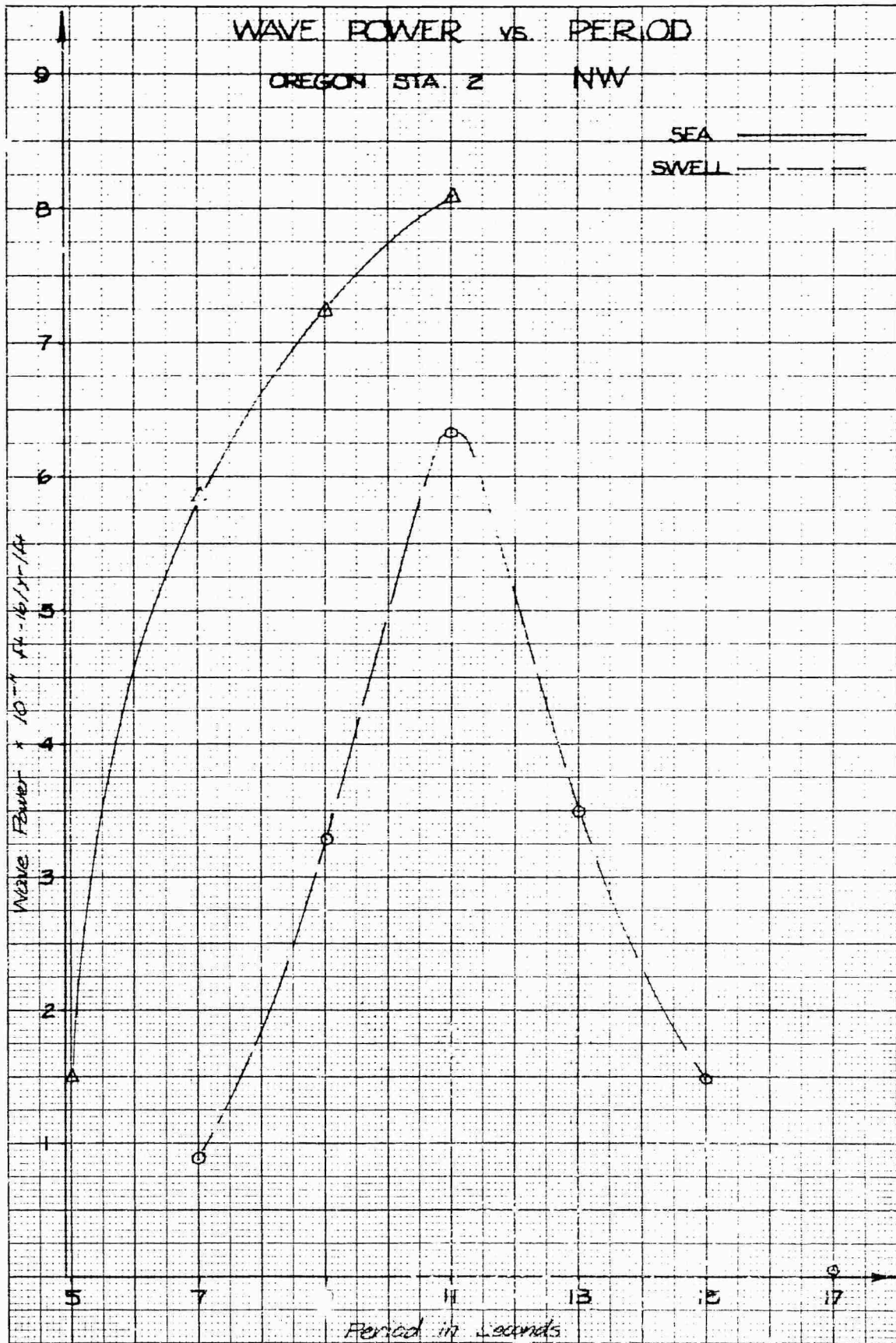
Wave Power $\frac{H^3}{T^4} \times 10^{-11}$



NO. 10 X 10 TO 1 1/2 INCH 46 1323
NEWELL & CO. NEW YORK

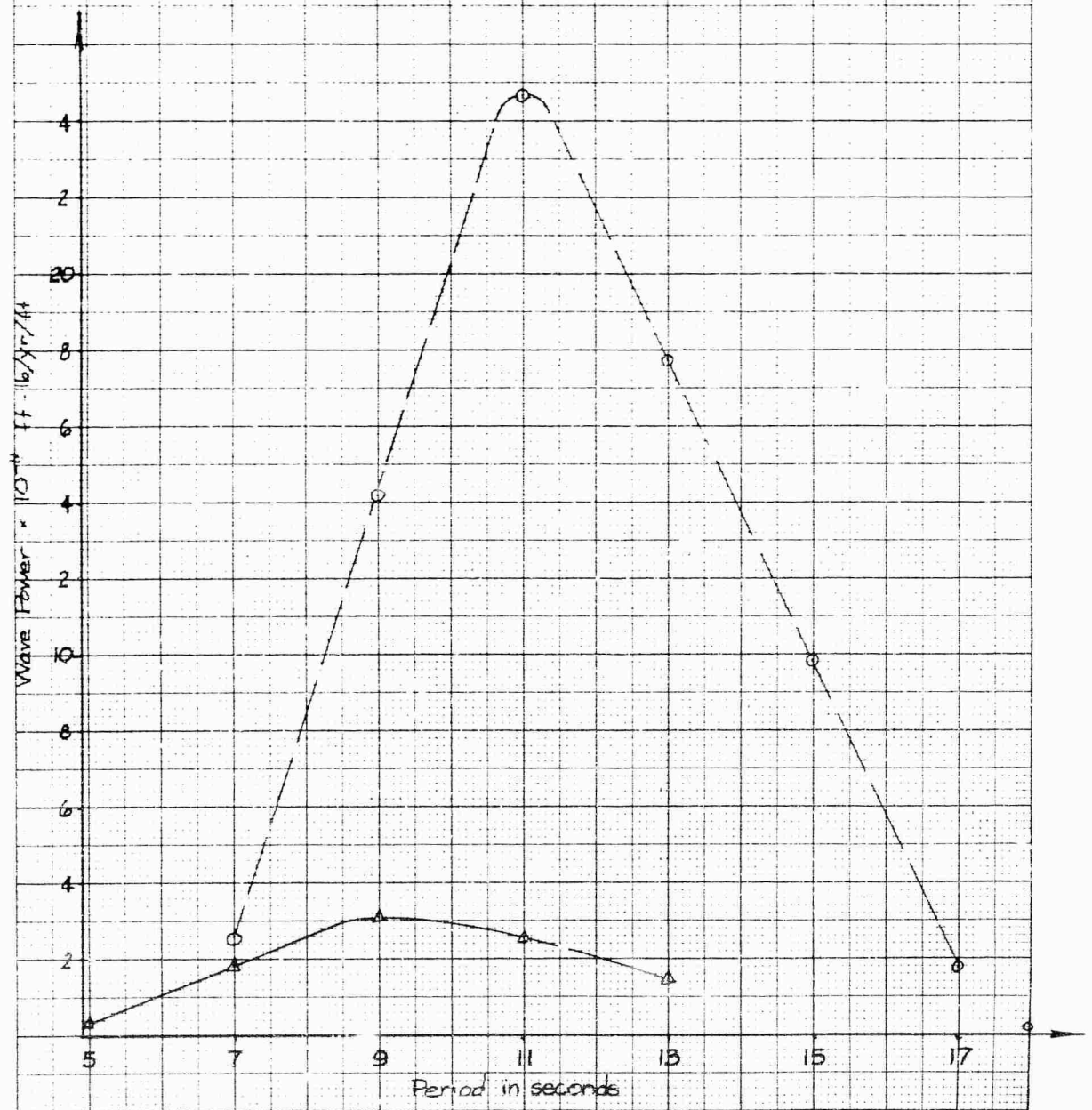


K&Z
10 X 10 TO 1 1/2 INCH 46 1323
K&Z ENGINEERING CO.
KEENE, N.H. 03435 U.S.A.



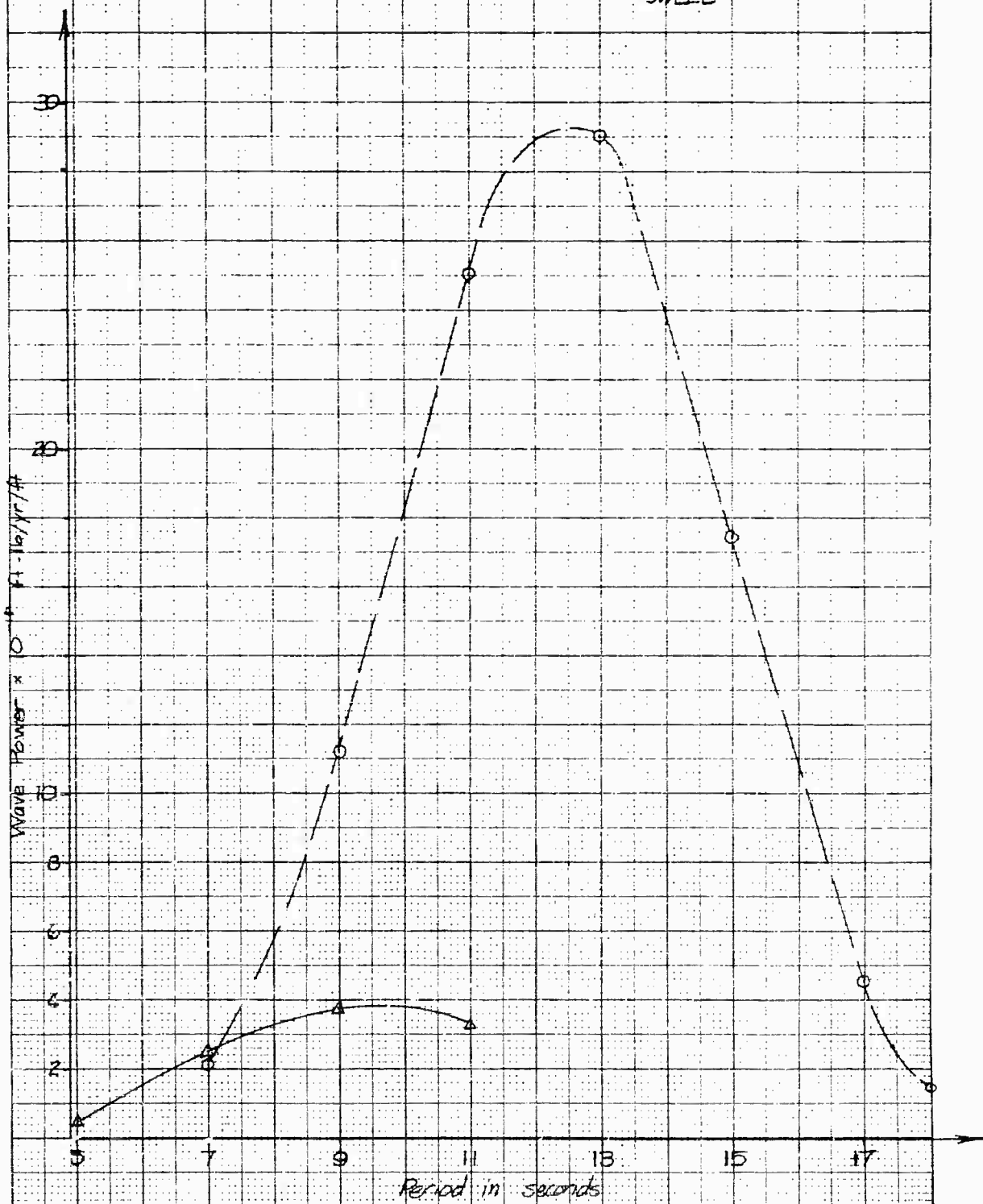
WAVE POWER vs PERIOD

OREGON STA 2 WNW

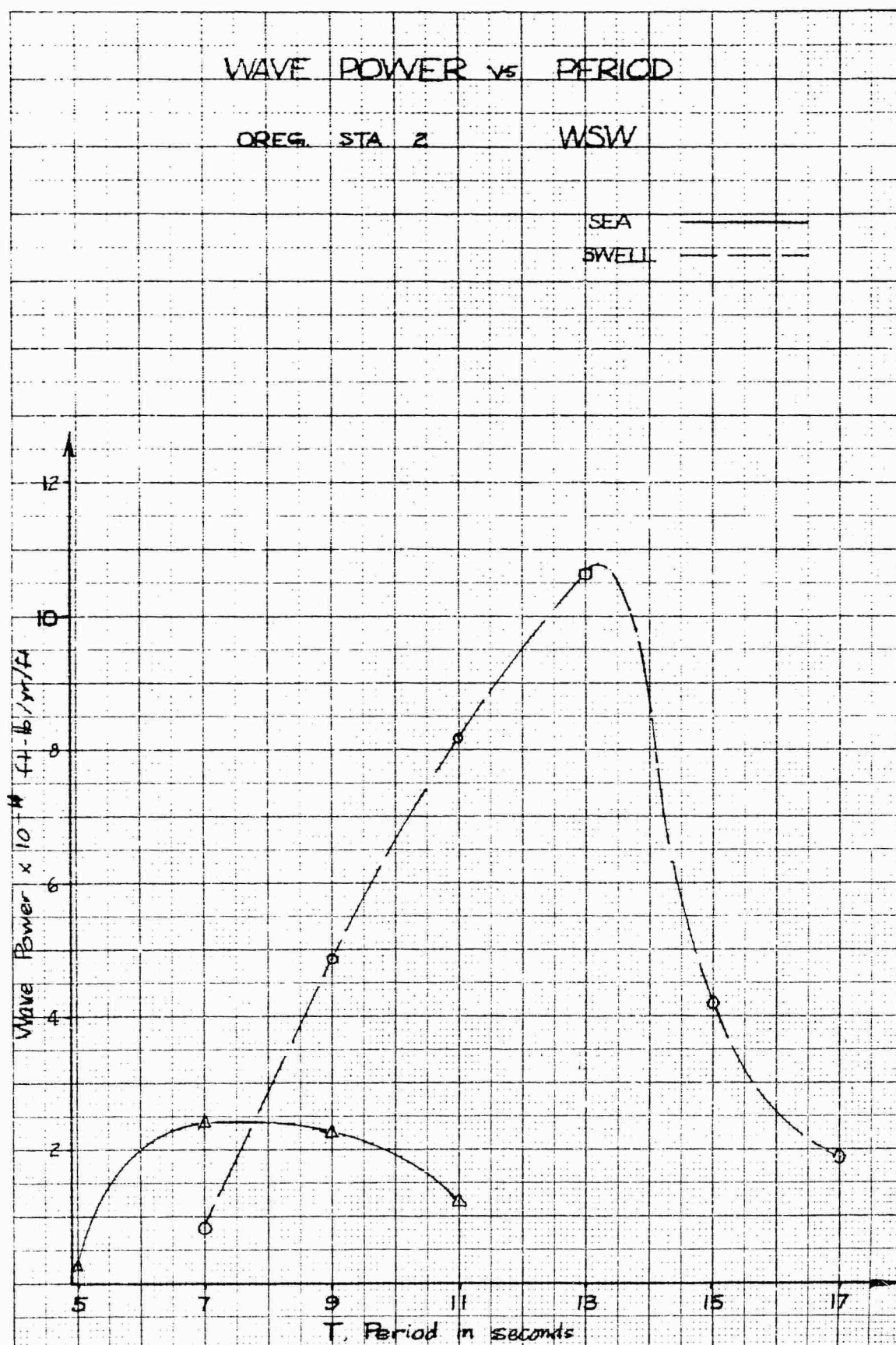
SEA ———
SWELL - - - -

WAVE POWER vs PERIOD

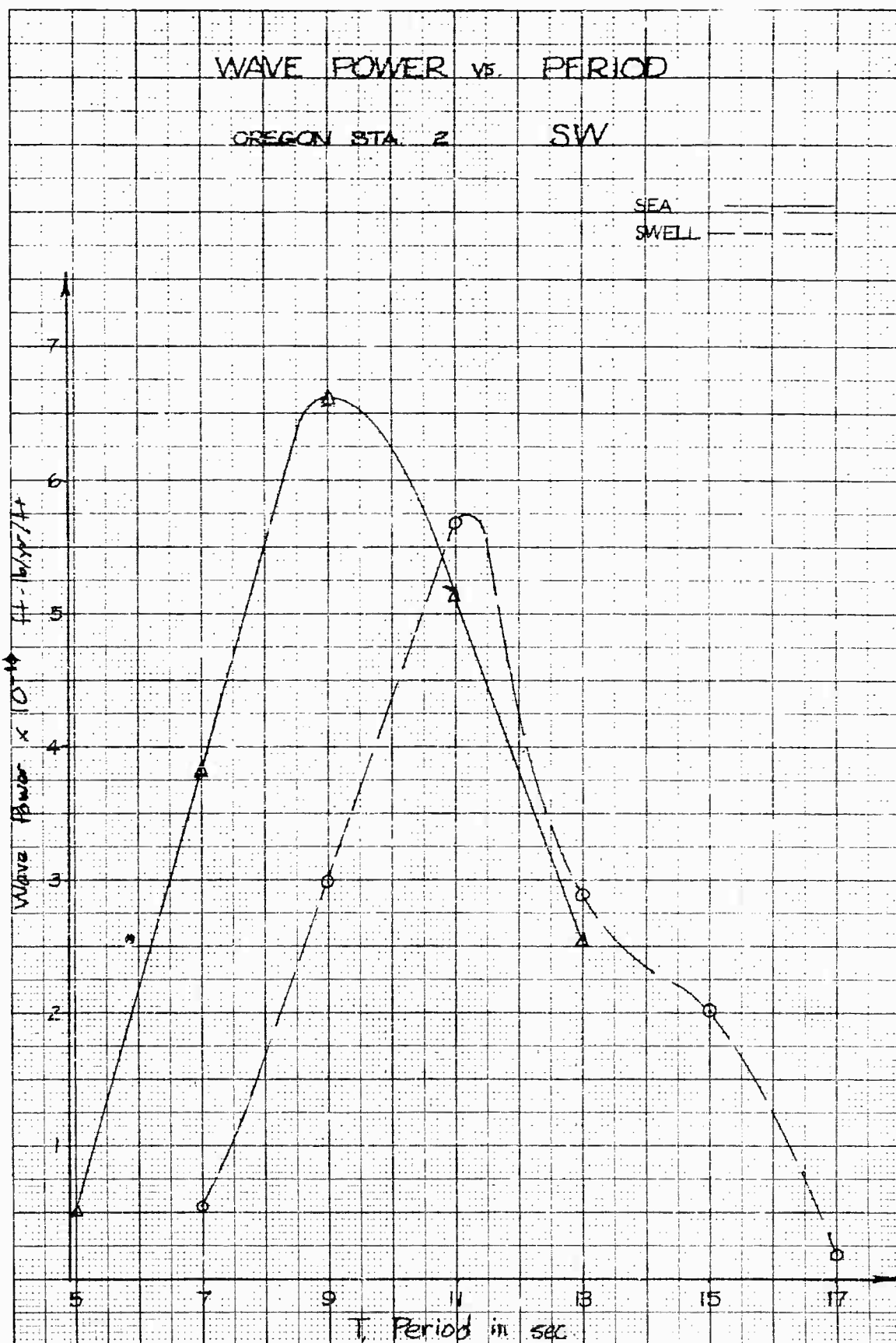
OREGON STA 2 W

SEA
SWELL

Plot on 10 x 10 to 1/2 inch 46 1323
 REPRODUCED FROM NCEM

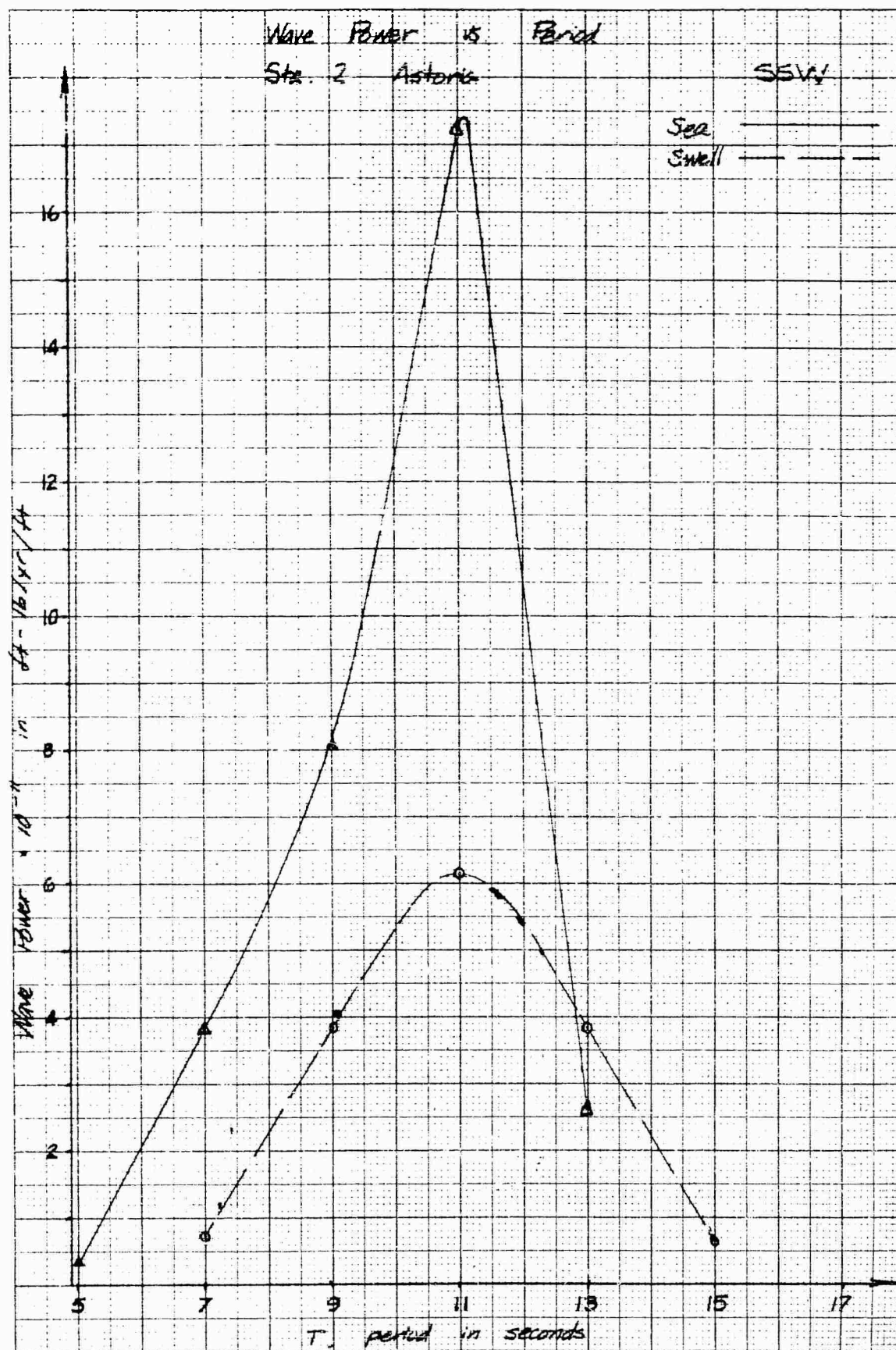


K&E 12 X 10 TO 1/2 INCH 46 1323
U.S. GOVERNMENT PRINTING OFFICE: 1964



REF. 10 X 10 TO 1/2 INCH 46 1323
 REF. 10 X 10 TO 1/2 INCH 46 1323
 REF. 10 X 10 TO 1/2 INCH 46 1323

NO. 10 X 10 TO 1 INCH 46 1323

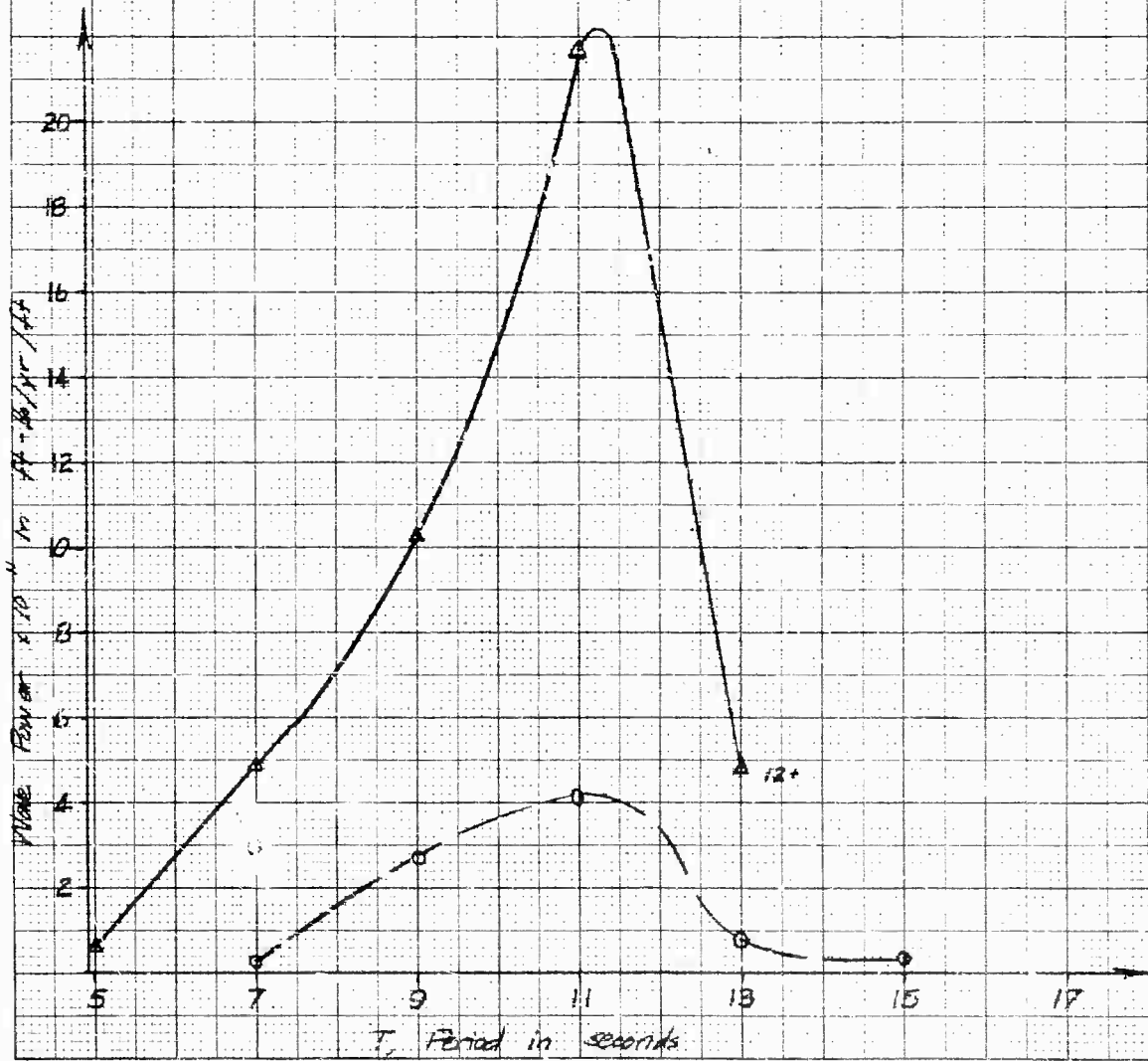


Wave Power vs. Period
Sta. 2 Oregon

S

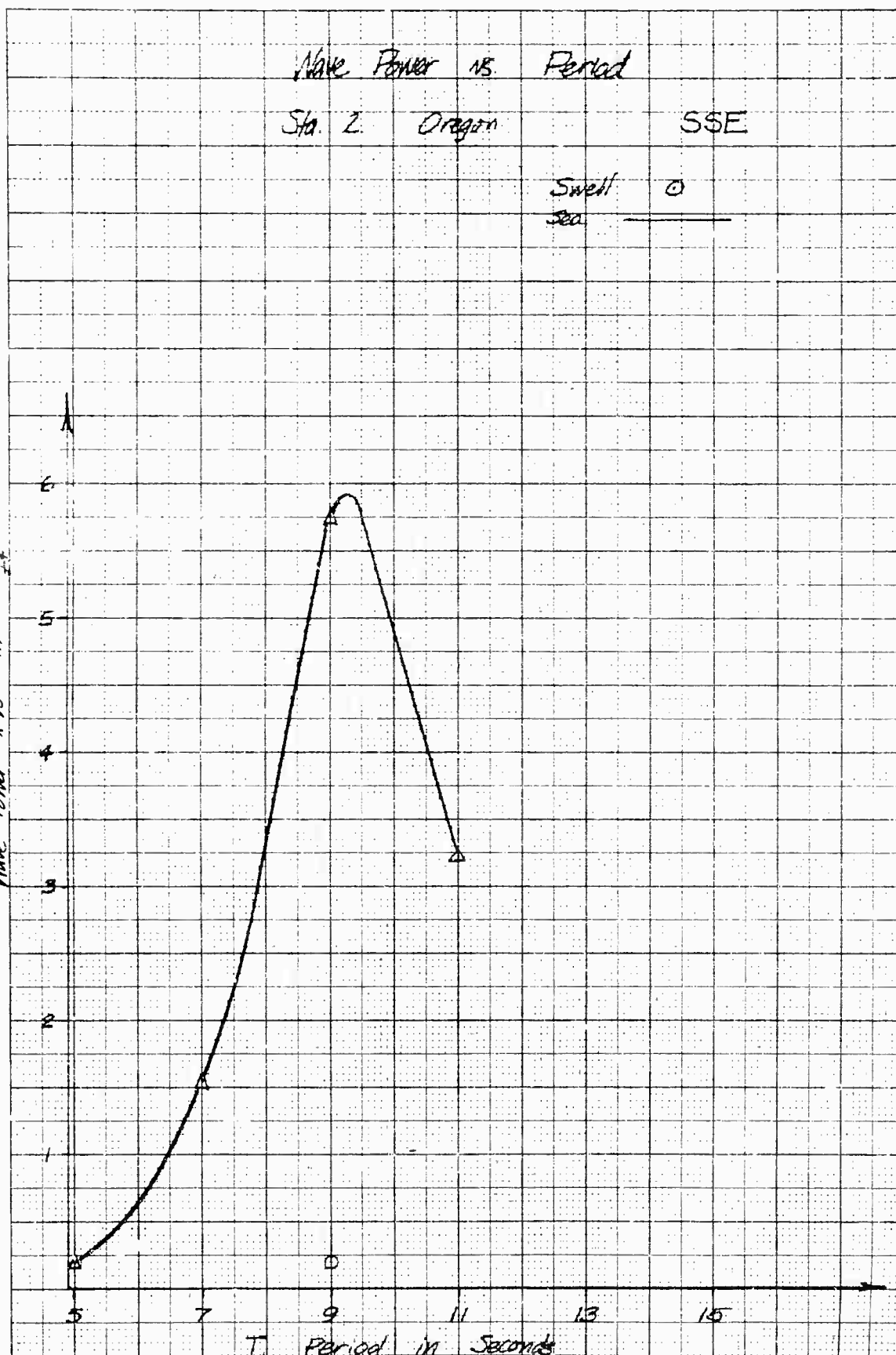
Spec

Spec



12 1/2" 10 X 10 TO 1 1/2" INCH 46 1323
 12 1/2" 10 X 10 TO 1 1/2" INCH 46 1323
 12 1/2" 10 X 10 TO 1 1/2" INCH 46 1323

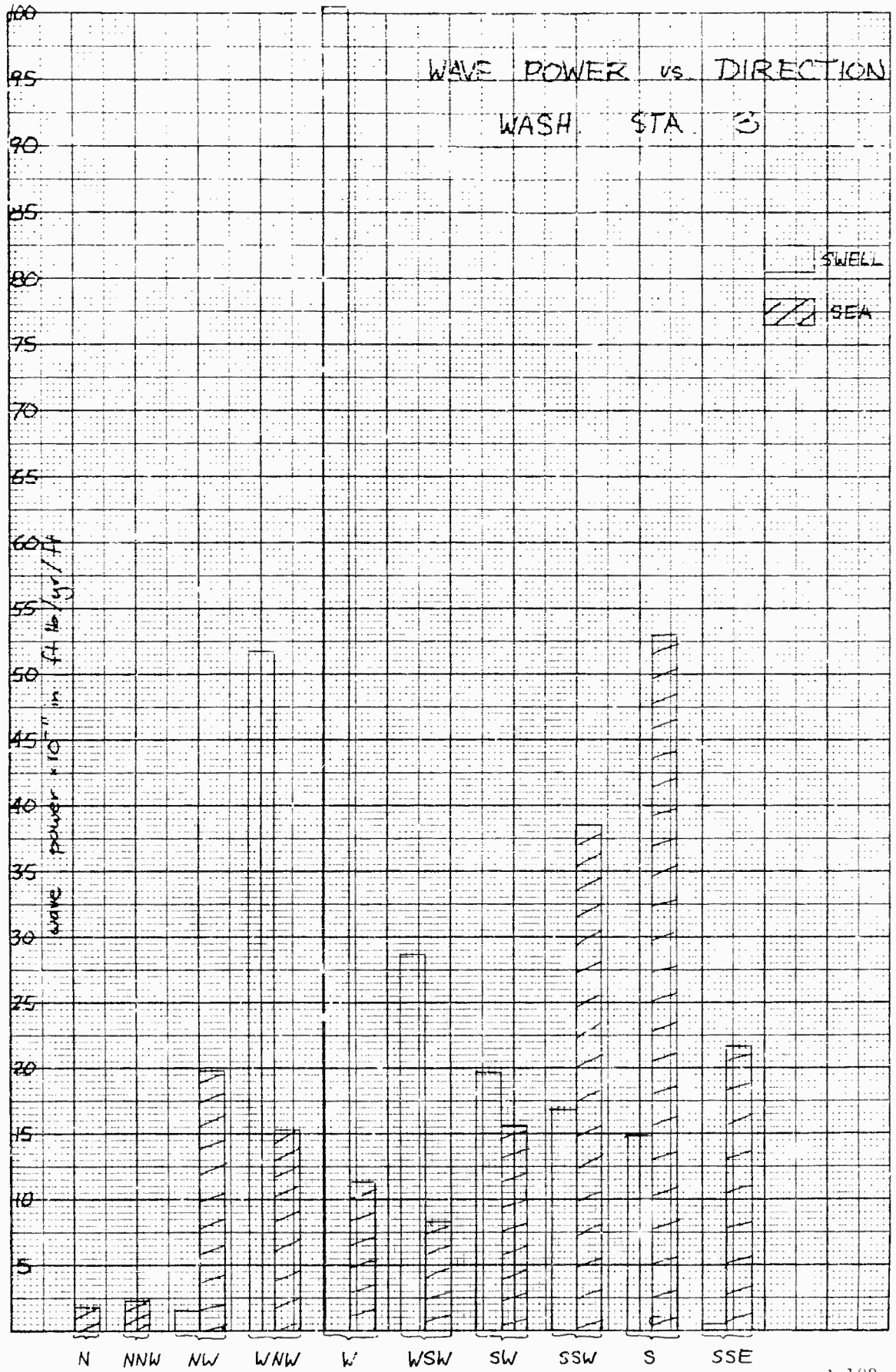
Wave Power $\times 10^{-11}$ in $\frac{\text{ft} \cdot \text{lb}}{\text{sec}}$

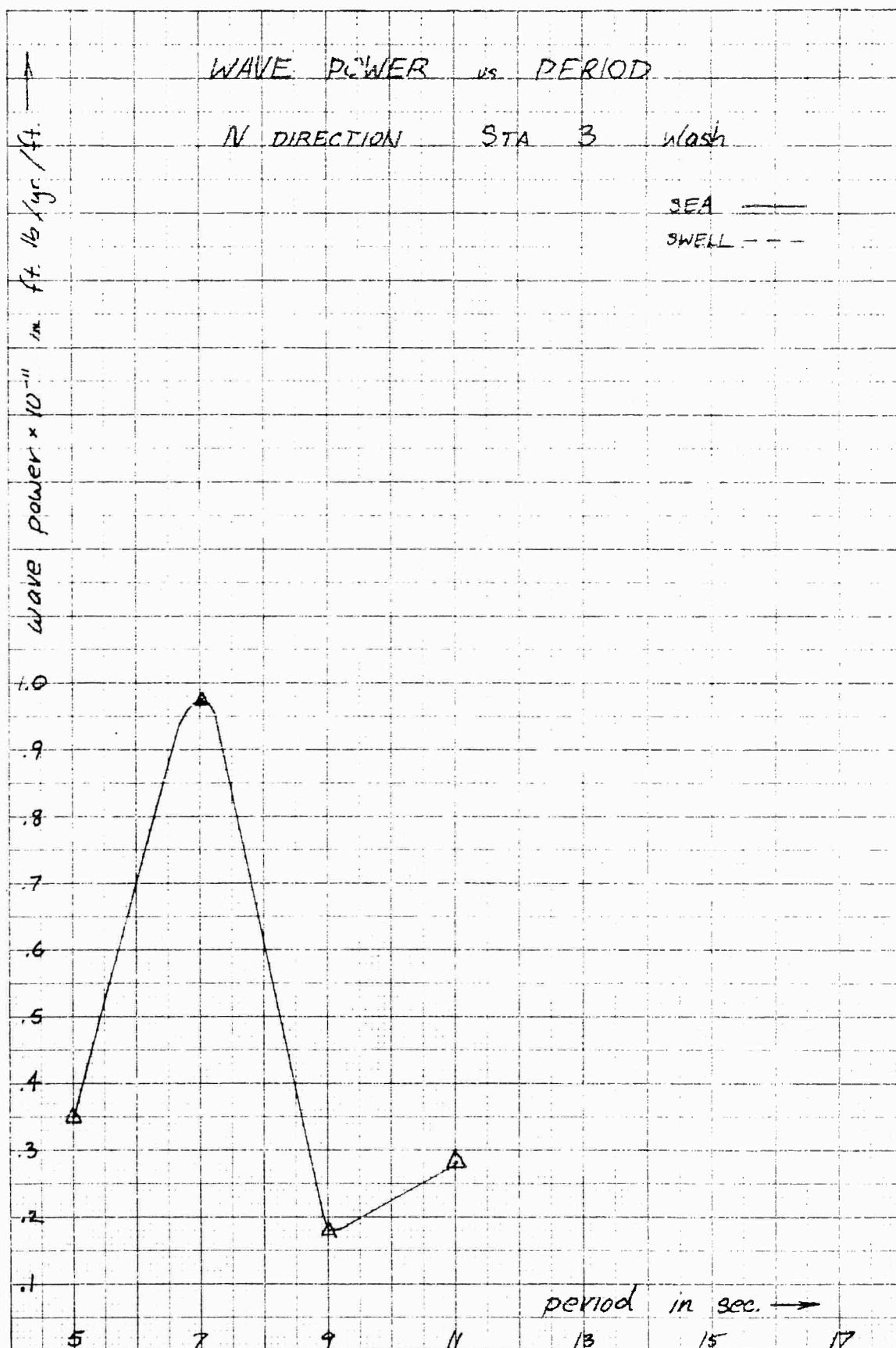


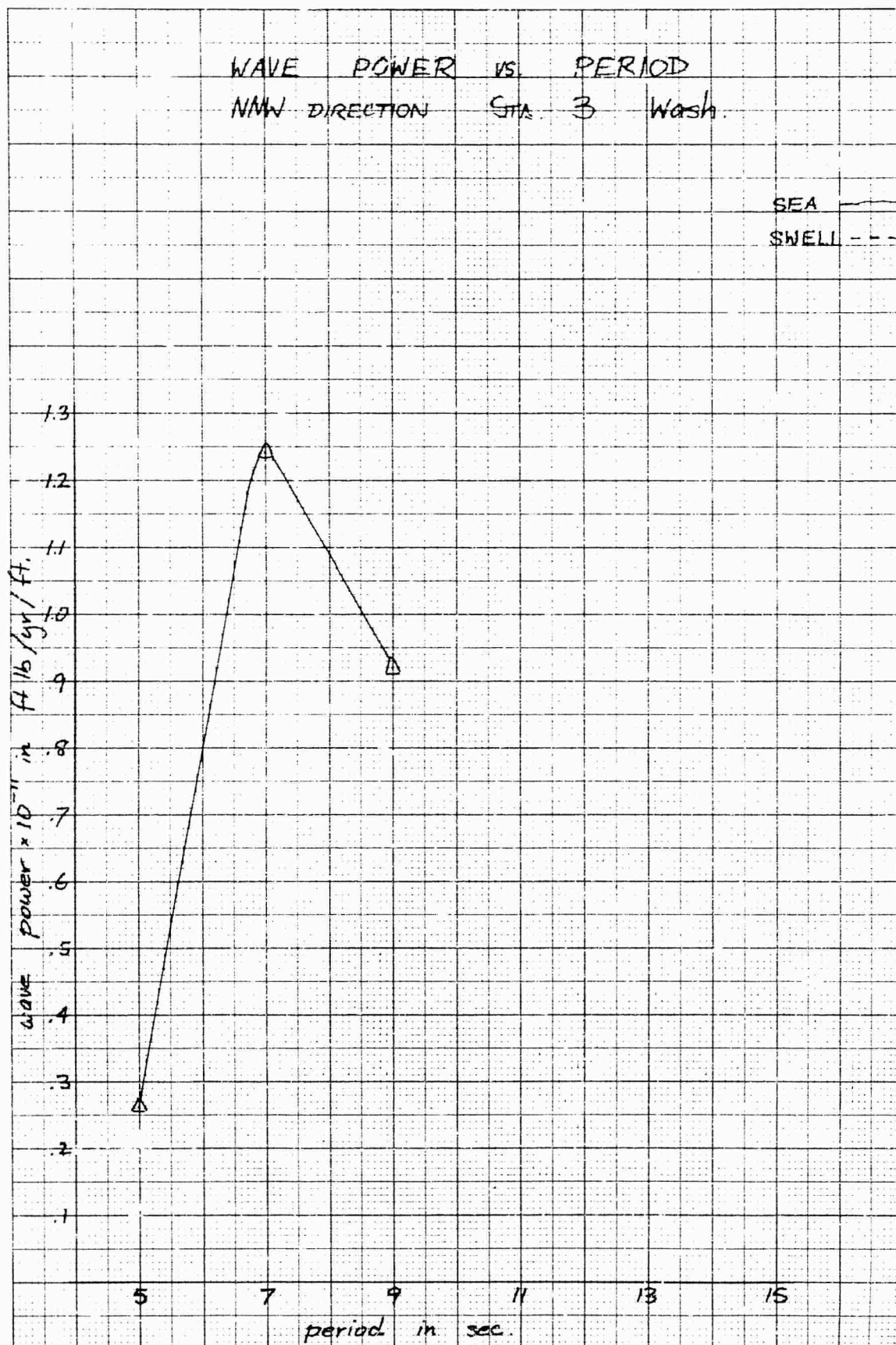
STATION 3 WASHINGTON COAST

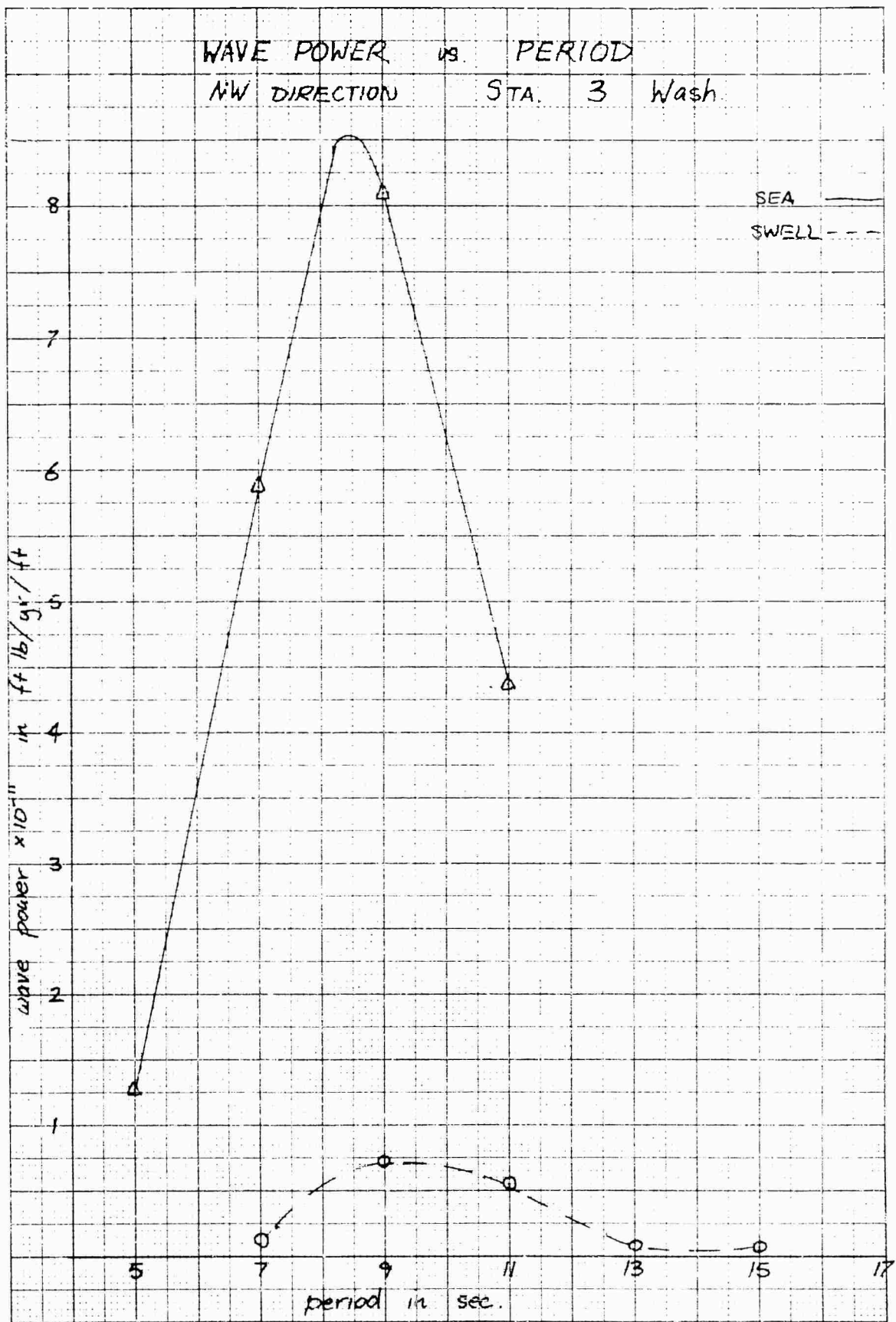
Lat. $47^{\circ} 40'N$, Long. $125^{\circ} 00'W$

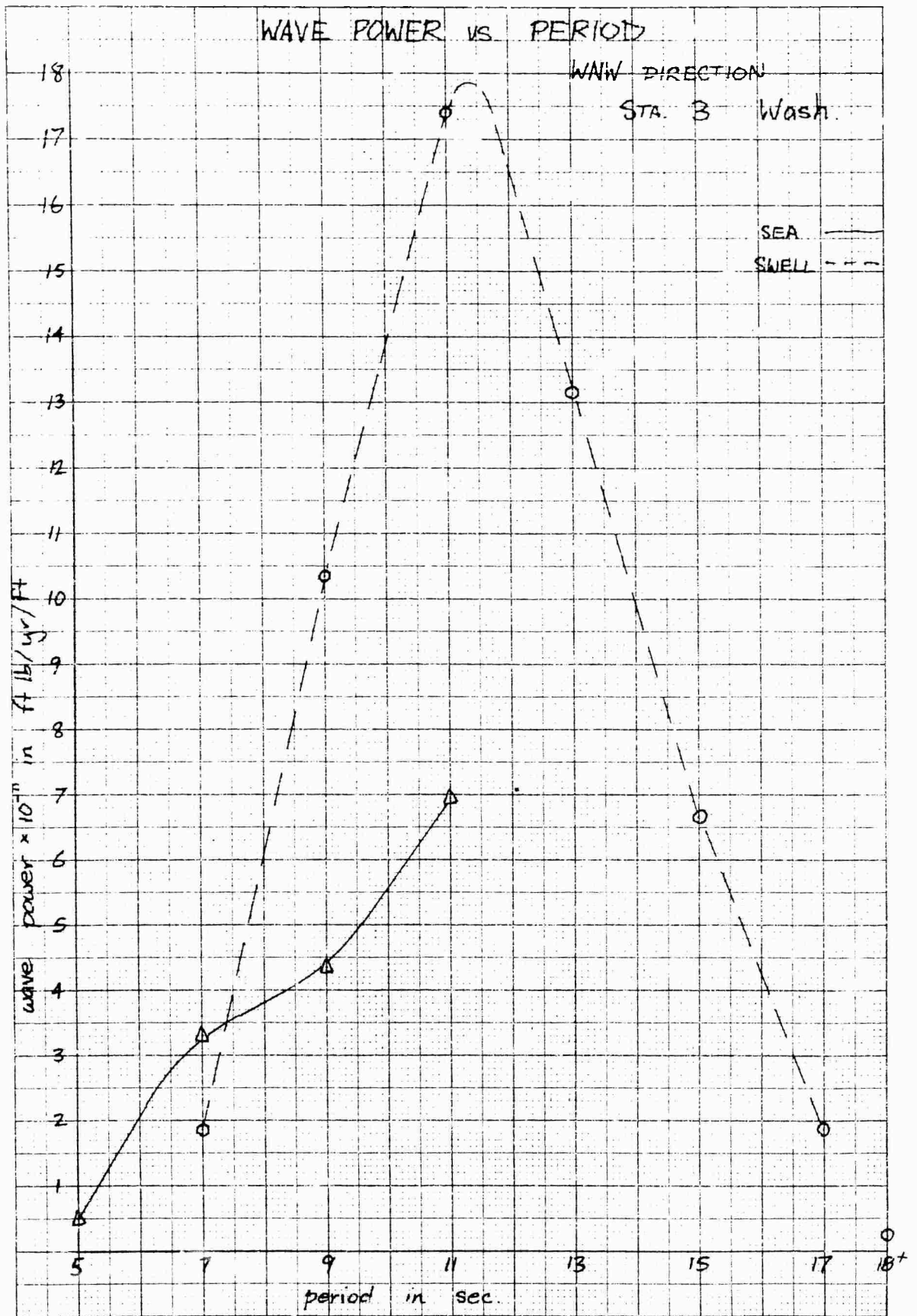
10 x 10 to 1/2 inch 48 1323
7 x 10 inches
MADE IN U.S.A.
KUPFER & ESSER CO.











WAVE POWER vs. PERIOD

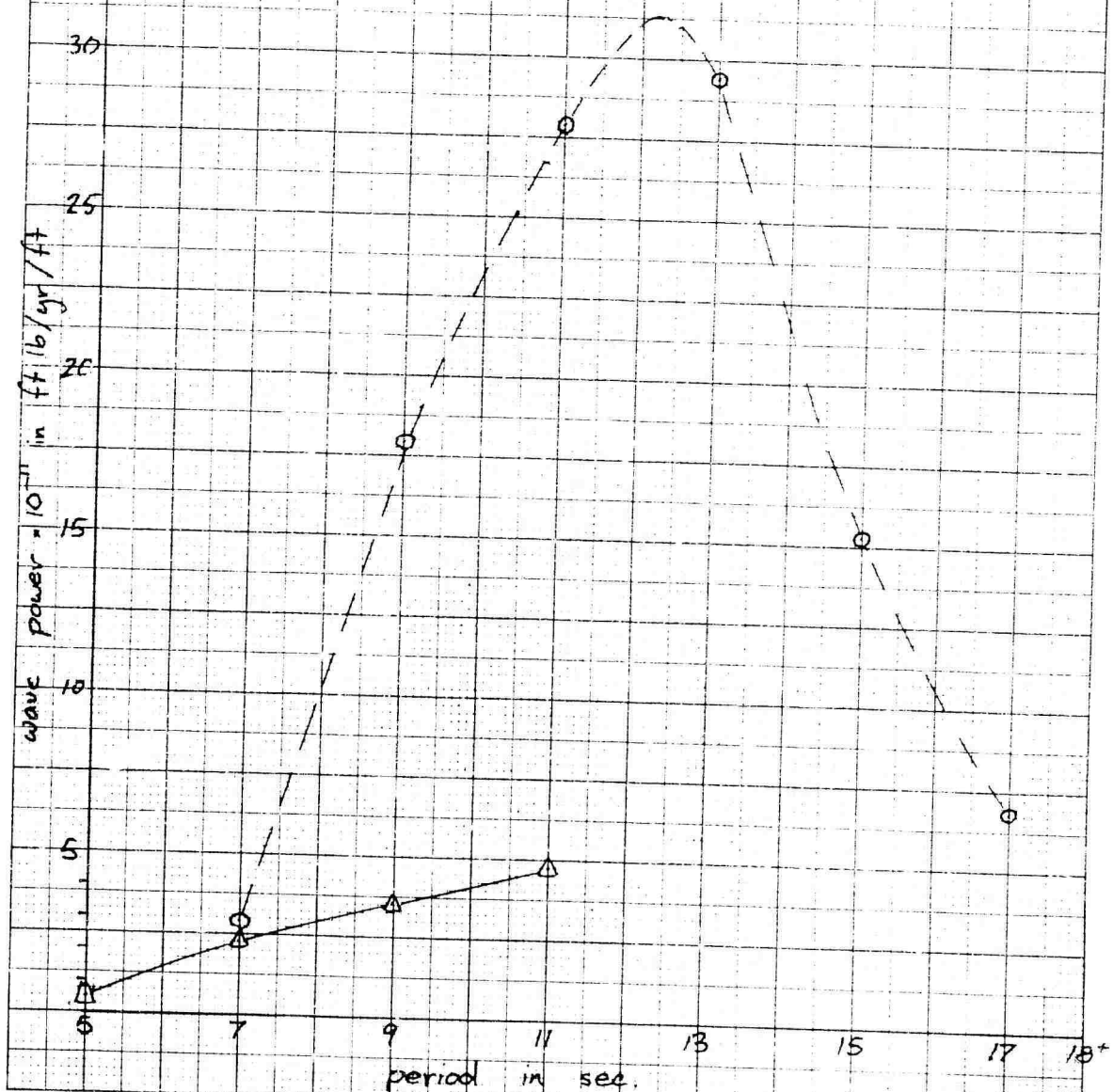
W DIRECTION

STA. 3

Wash.

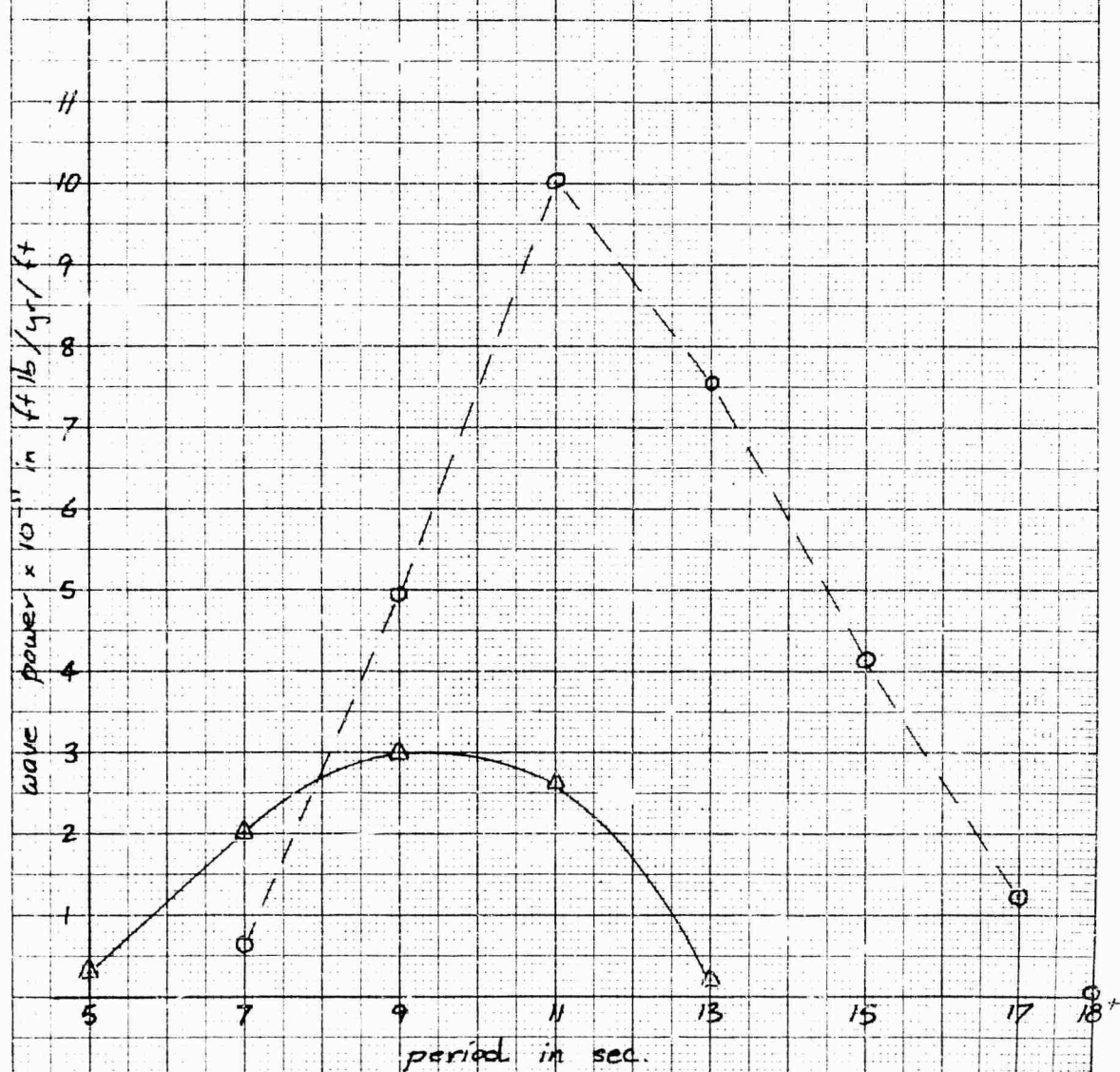
SEA — —

SWELL - - -



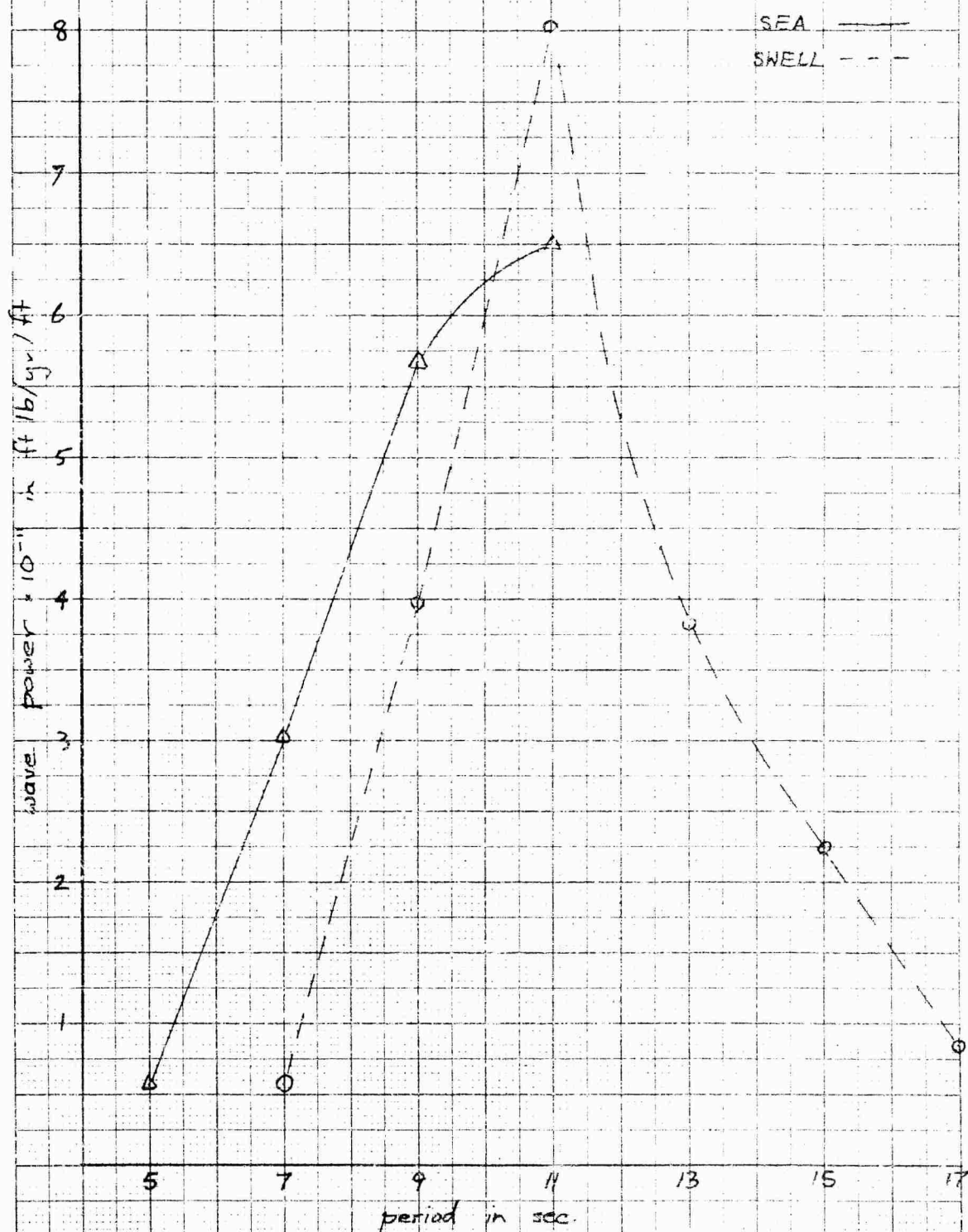
WAVE POWER vs PERIOD

WSW DIRECTION STA. 3 Wash

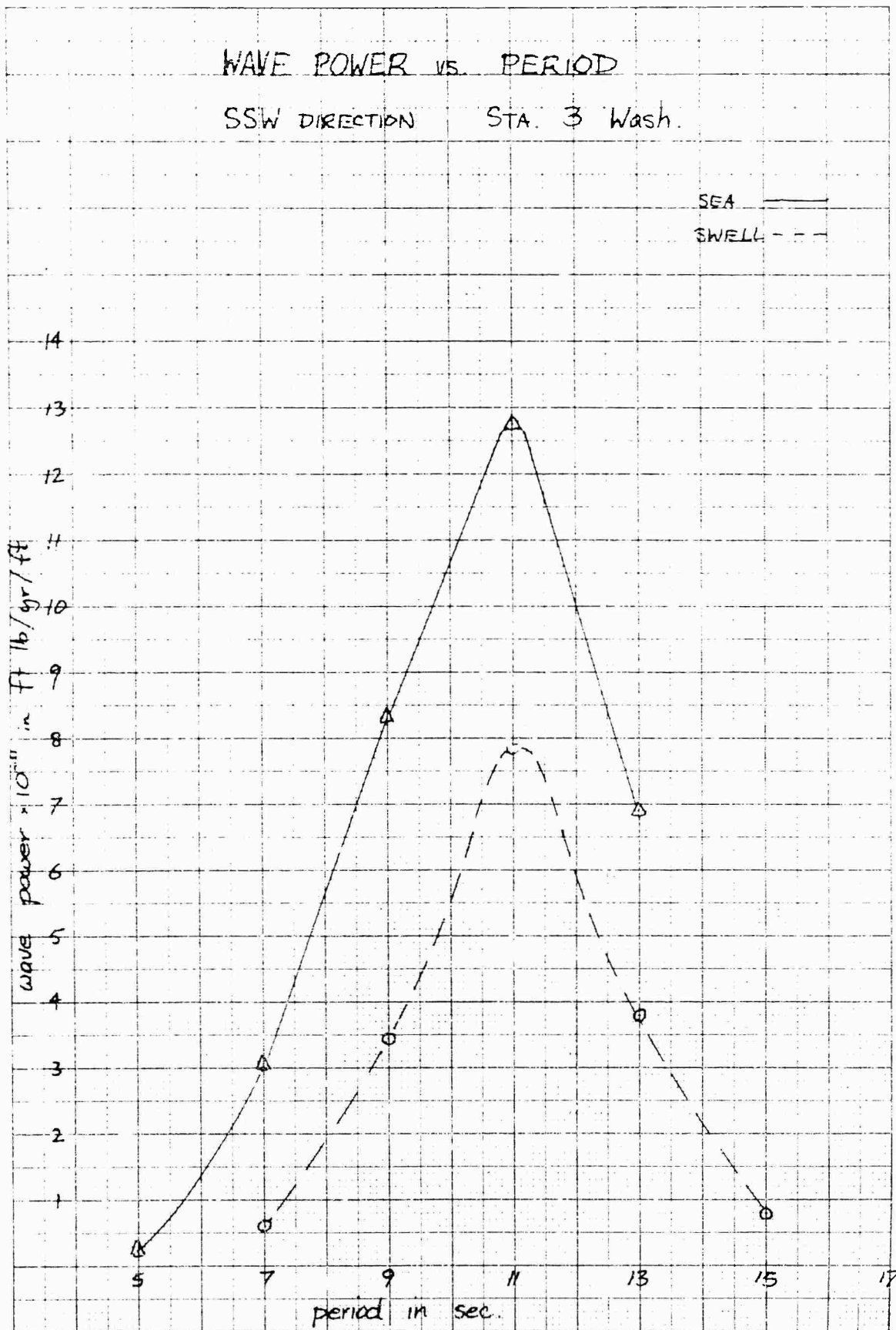
SEA ———
SWELL - - -

WAVE POWER vs. PERIOD

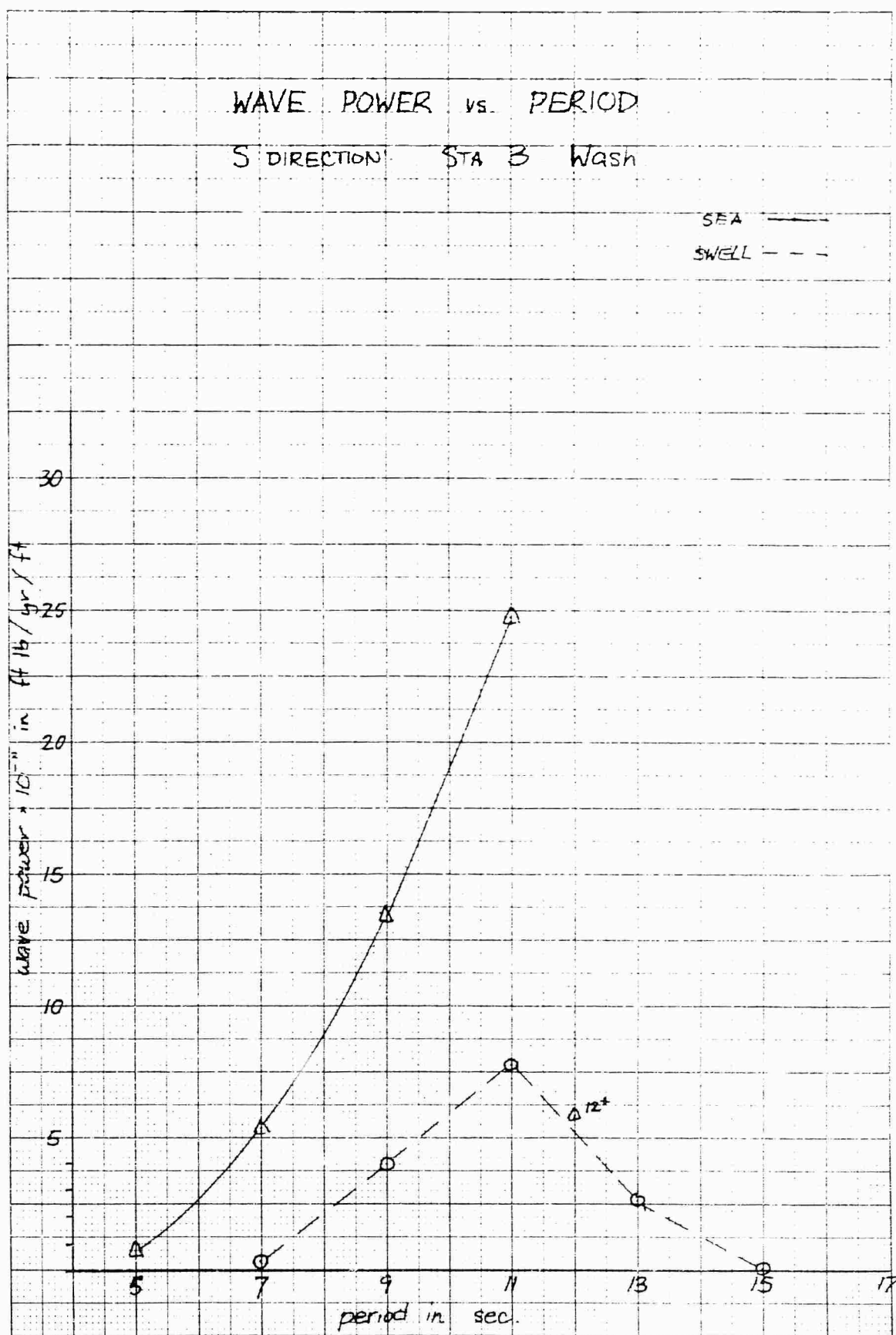
SW DIRECTION STA. 3 Wash.



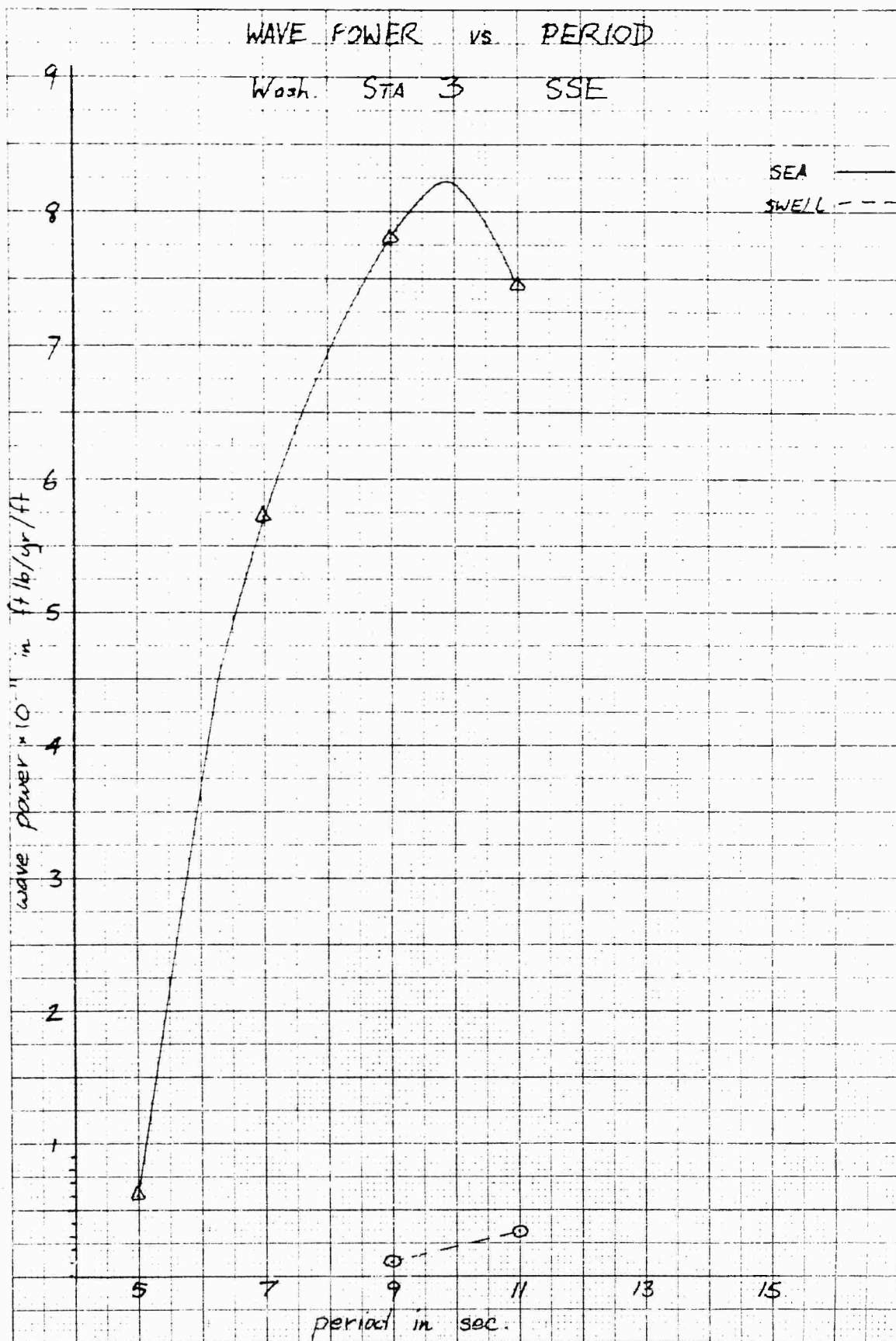
1707 14A 10 10 1 10 11 46 1323



12 X 10 TO 1/2 INCH 46 1323
U.S. GOVERNMENT PRINTING OFFICE
WASHINGTON, D.C.



1202 10/10/10-10/10/10 46 1323



APPENDIX B

WAVE POWER FOR VARIOUS MONTHS

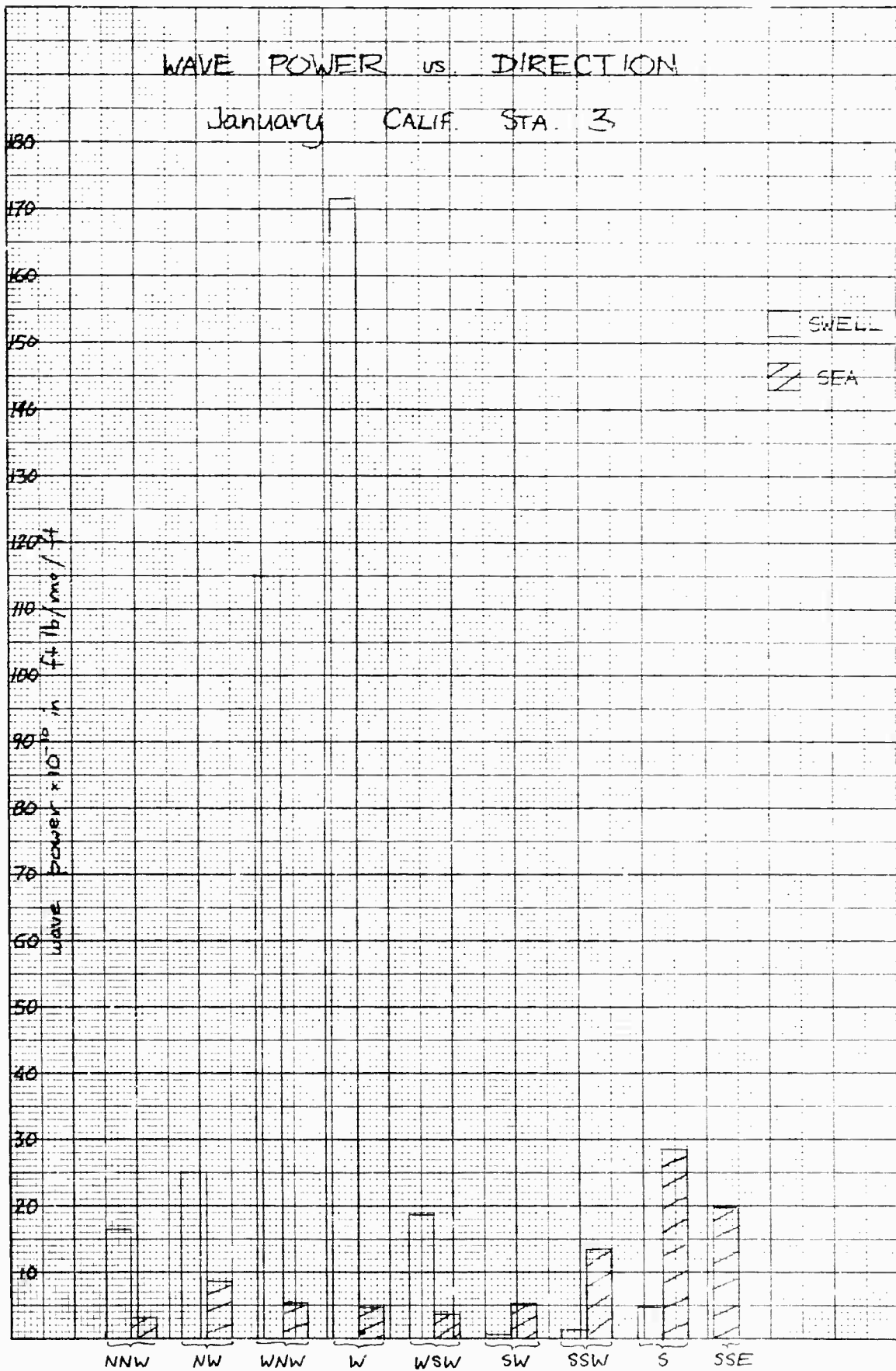
STATION 3 - CALIFORNIA COAST

Lat. 37.6°N Long. 123.5°W

STATION 3 - JANUARY

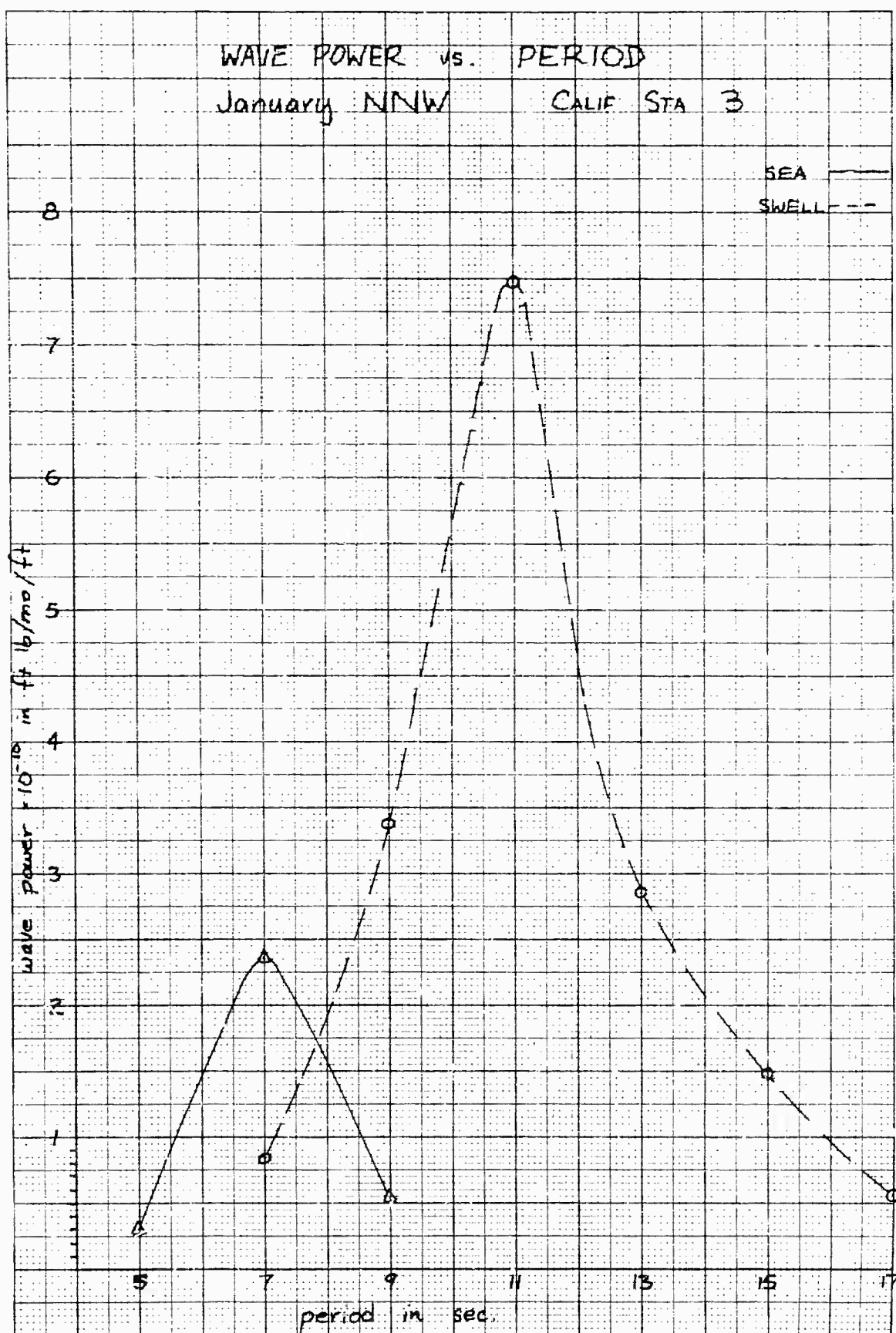
WAVE POWER vs. DIRECTION

January CALIF. STA. 3



K&E 10 X 10 TO 1/2 INCH 48 1323
7 X 10 INCHES 48 1323
KEUFFEL & ESSER CO.

KS 10 X 10 TO 1 1/2 INCH 46 1323
 1 1/2 X 10 IN. 46 1323
 COPY LATER

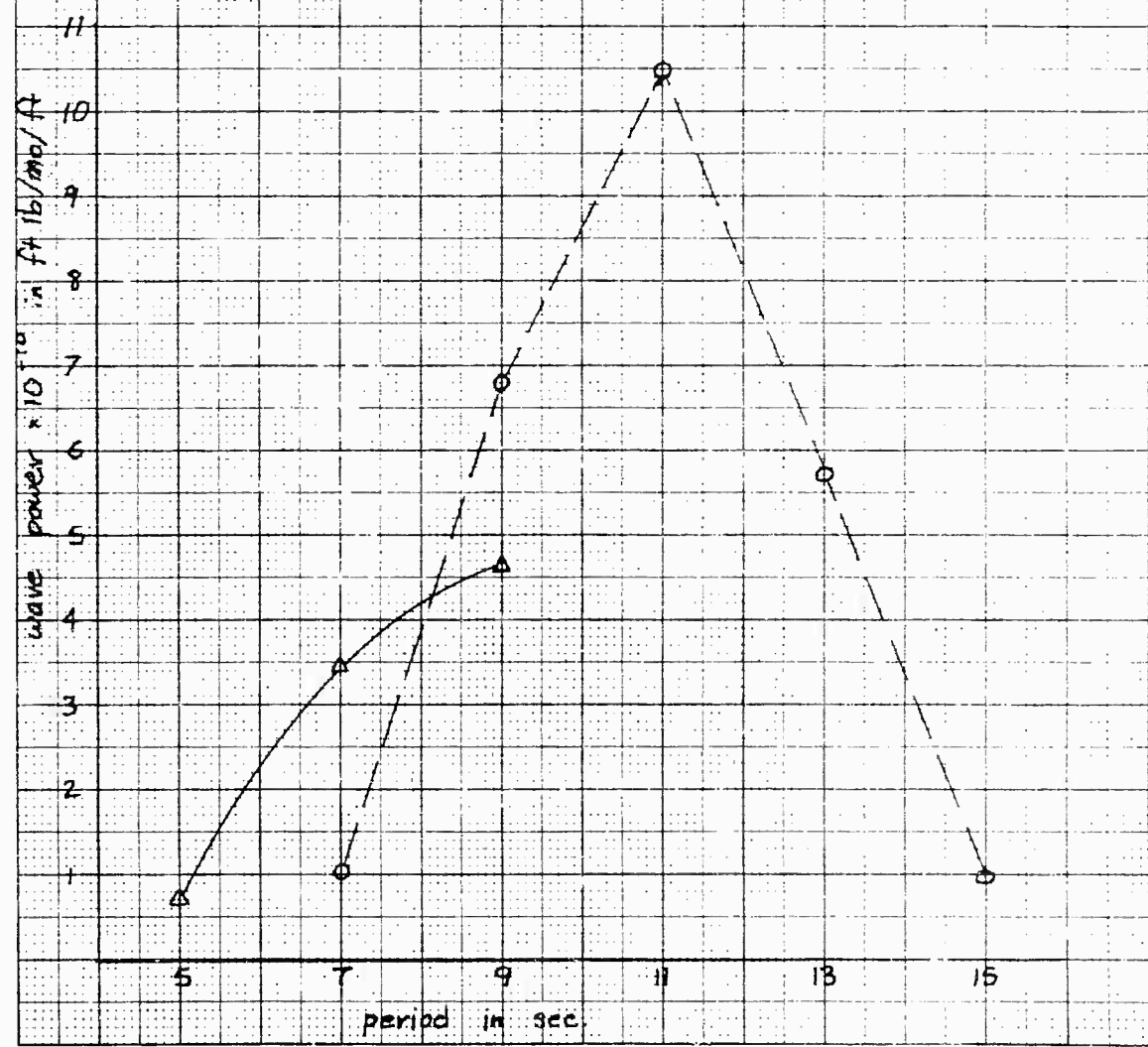


WAVE POWER vs. PERIOD

January NW

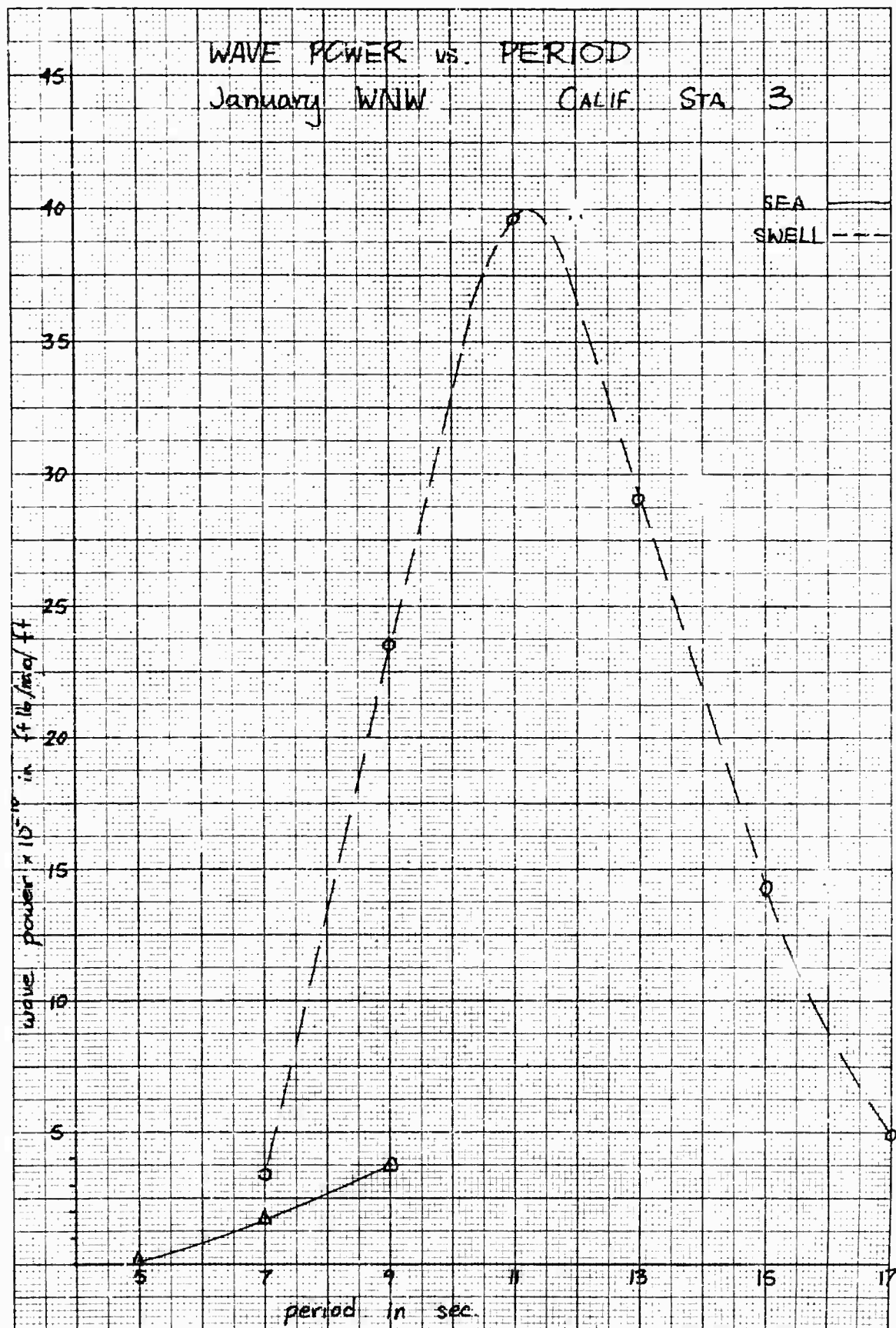
CALIF STA 3

SEA ———
SWELL - - -

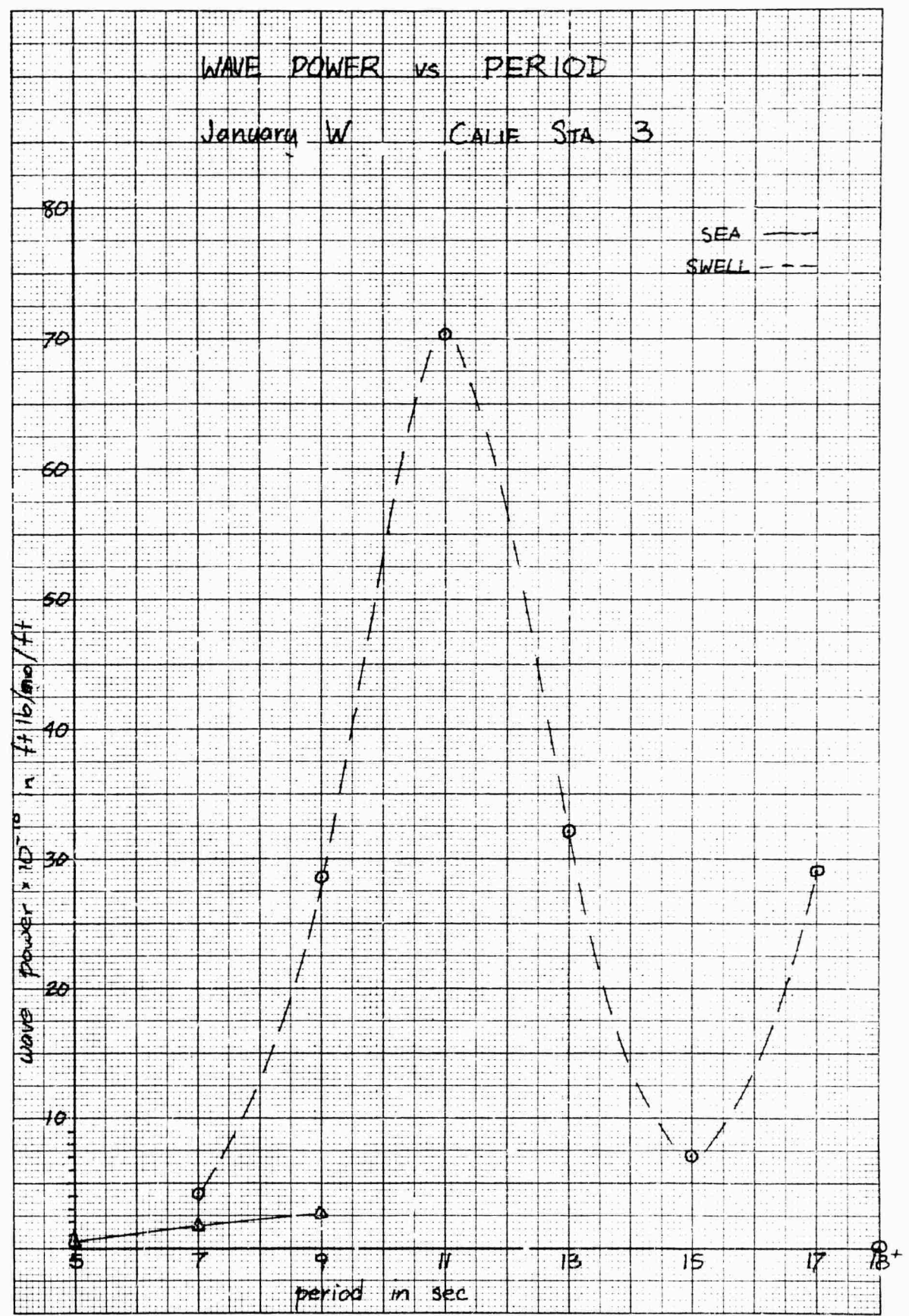


K&E 10 x 10 to 1 1/2 INCH 46 1323
P. OFFICE 4 1309 410

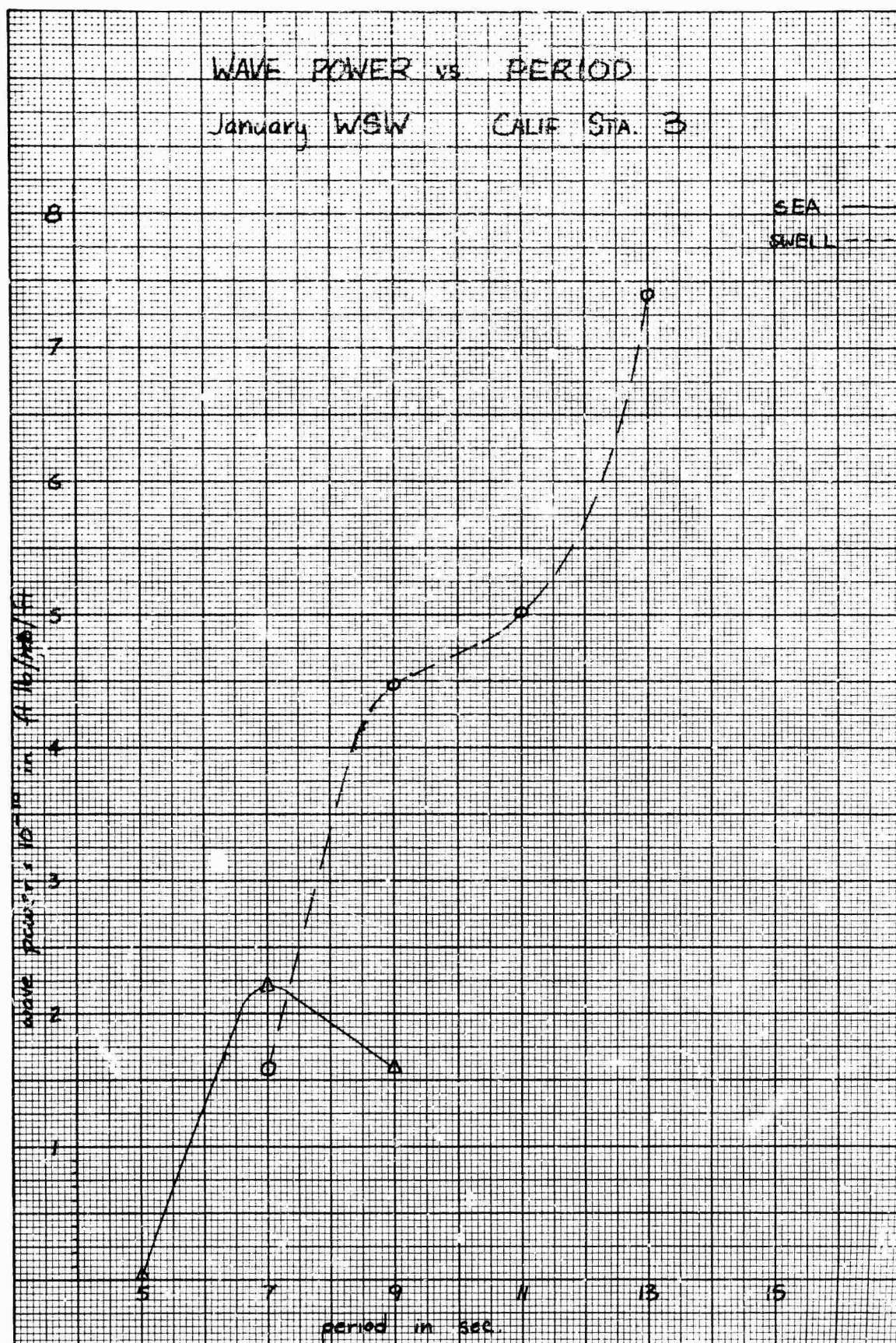
K&E 10 X 10 TO 1 1/2 INCH 46 1323
 1/2 X 1/2 INCHES 1/2 INCHES
 KIEFFEL & ESSEY CO.



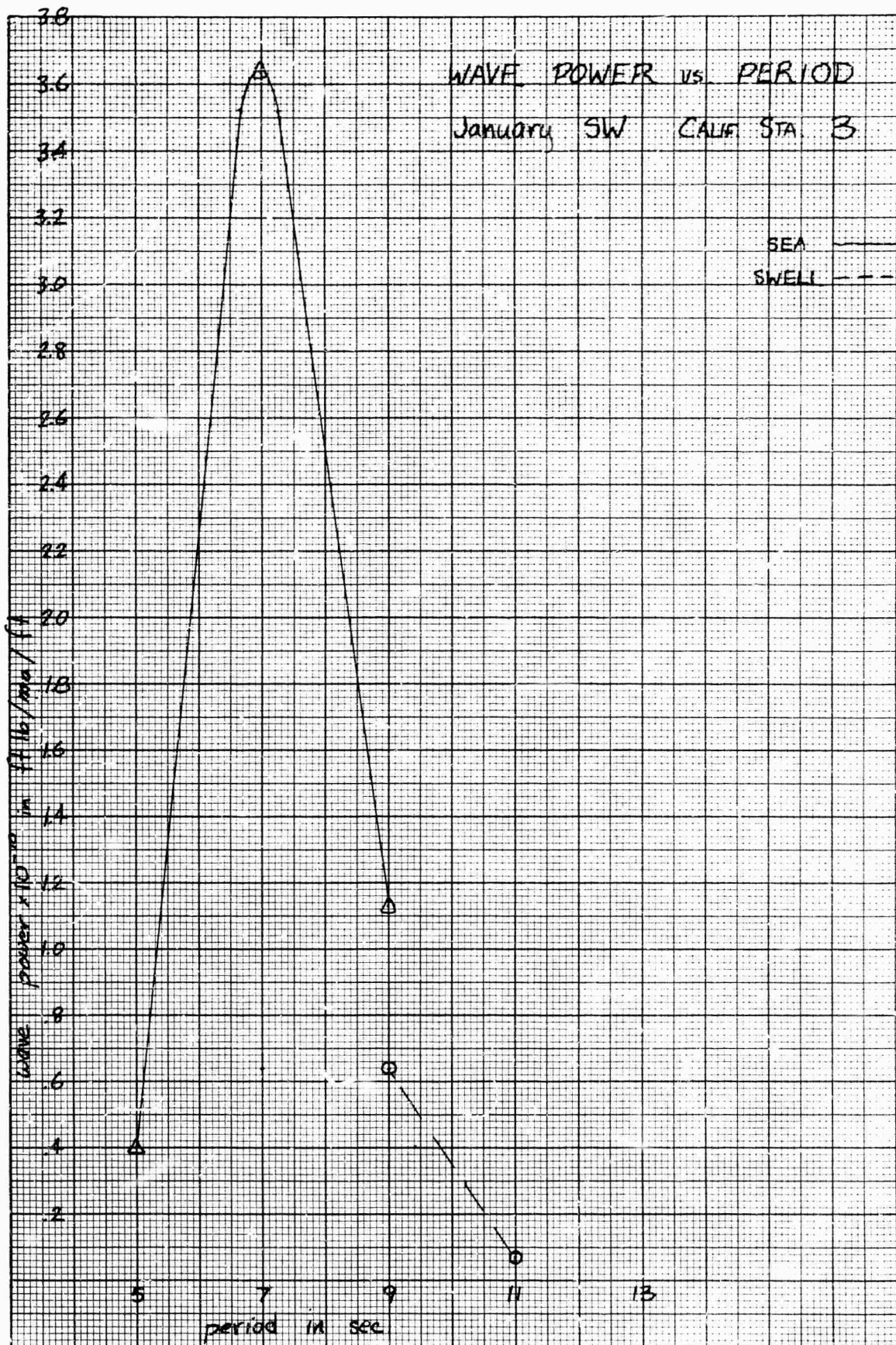
K&W 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.



K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

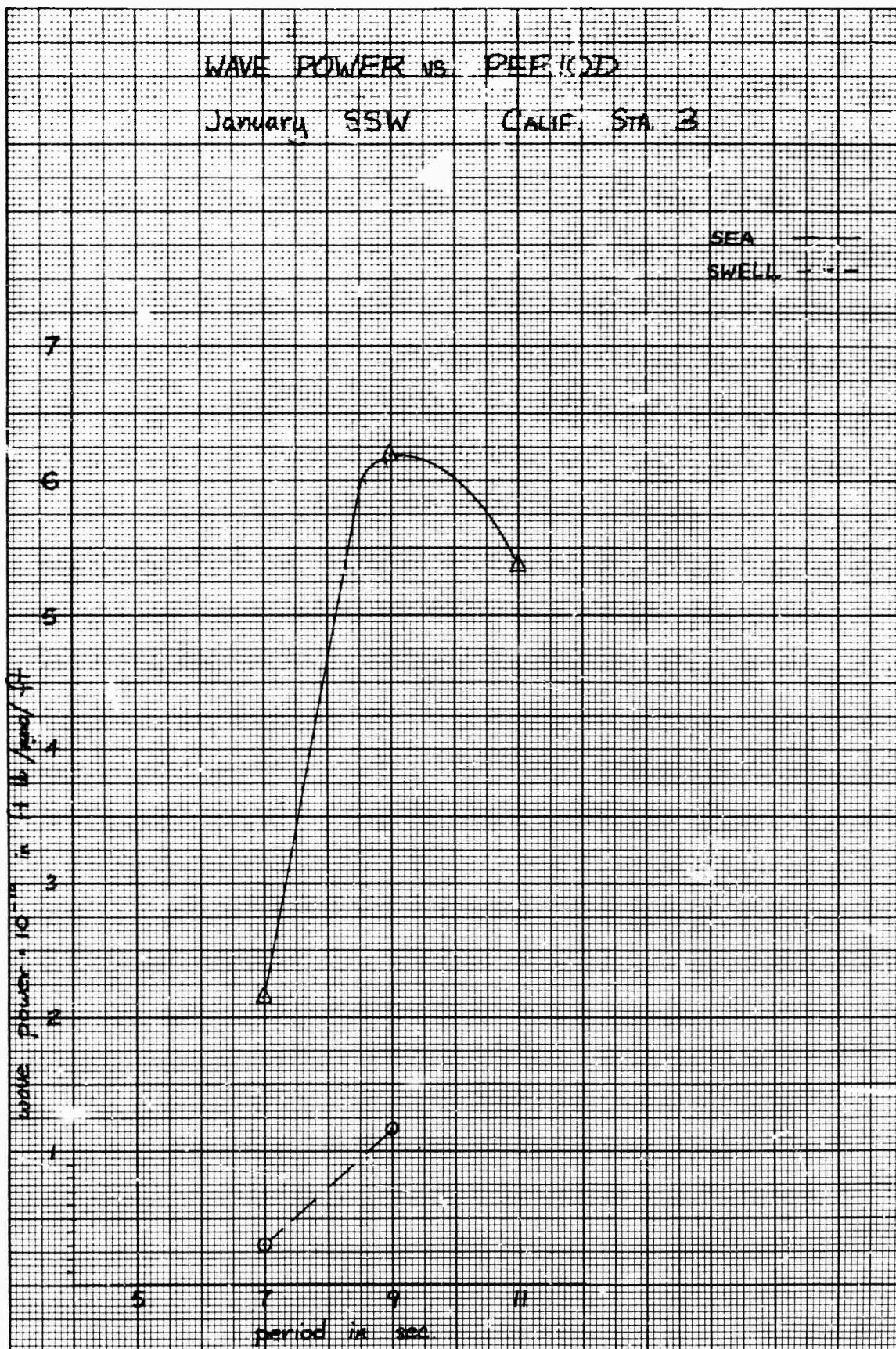


K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



WAVE POWER VS. PERIOD

January SSW CALIF. STA 3

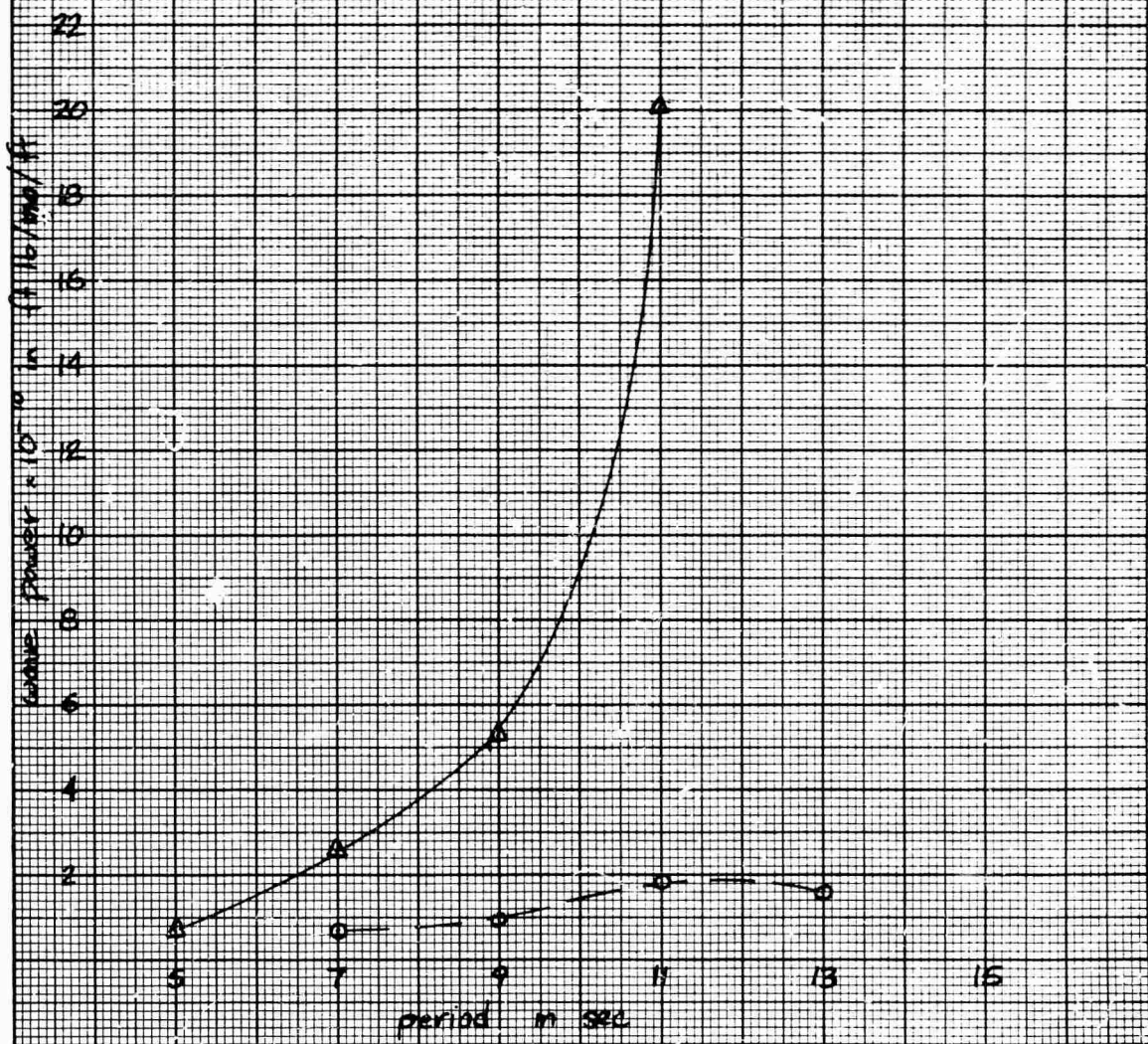
SEA ———
SWELL - - -

K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

WAVE POWER vs PERIOD

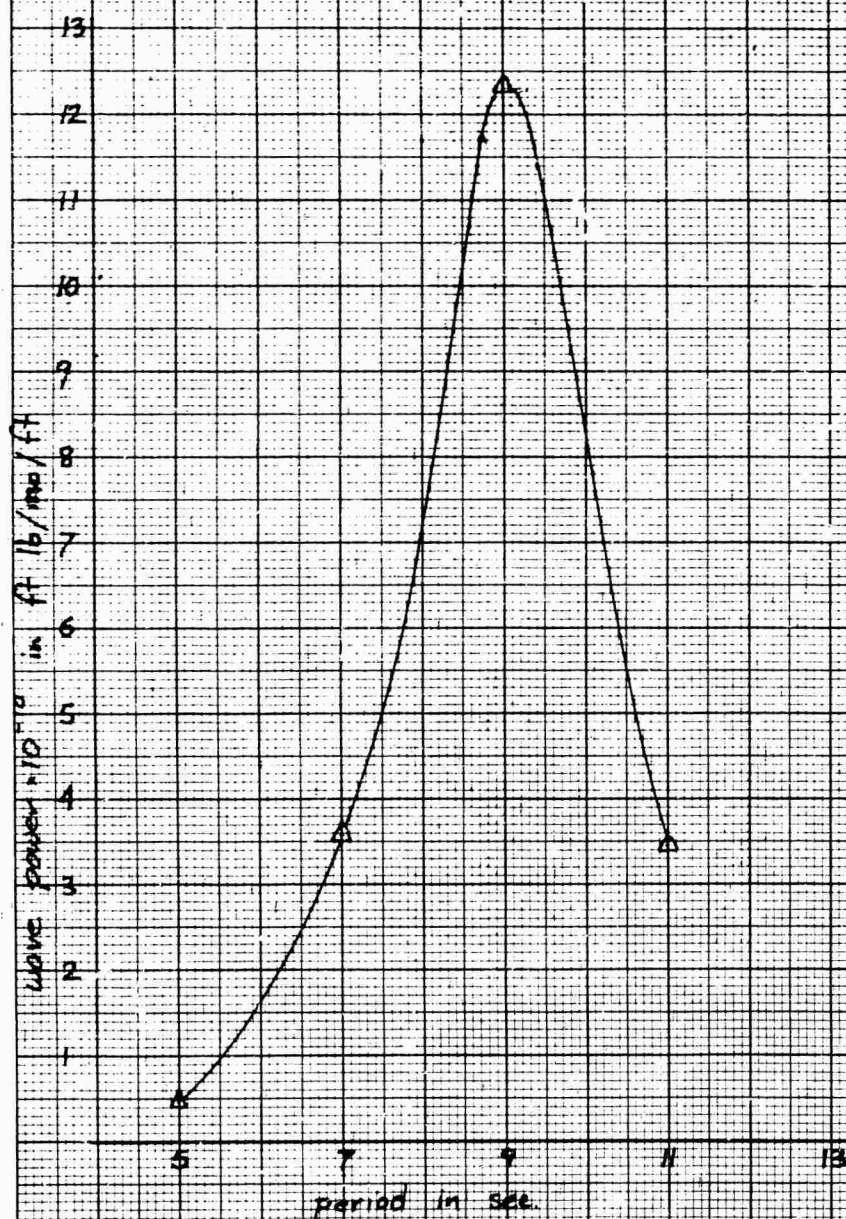
January 5 CALIF. STA. 3

SEA _____
SWELL _____



WAVE POWER vs. PERIOD
January SSE CALIF STA. 3

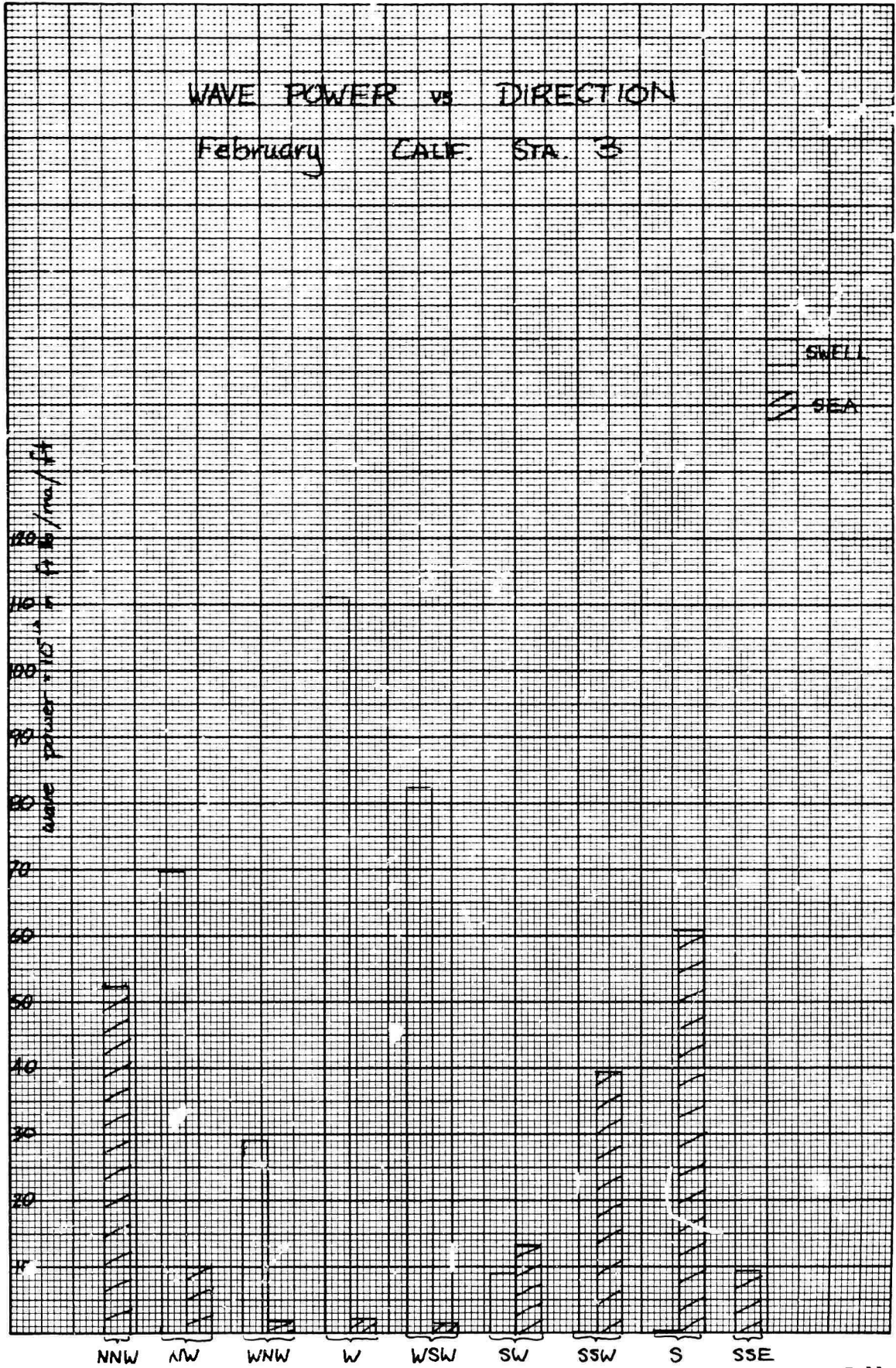
SEA ———
SWELL - - -



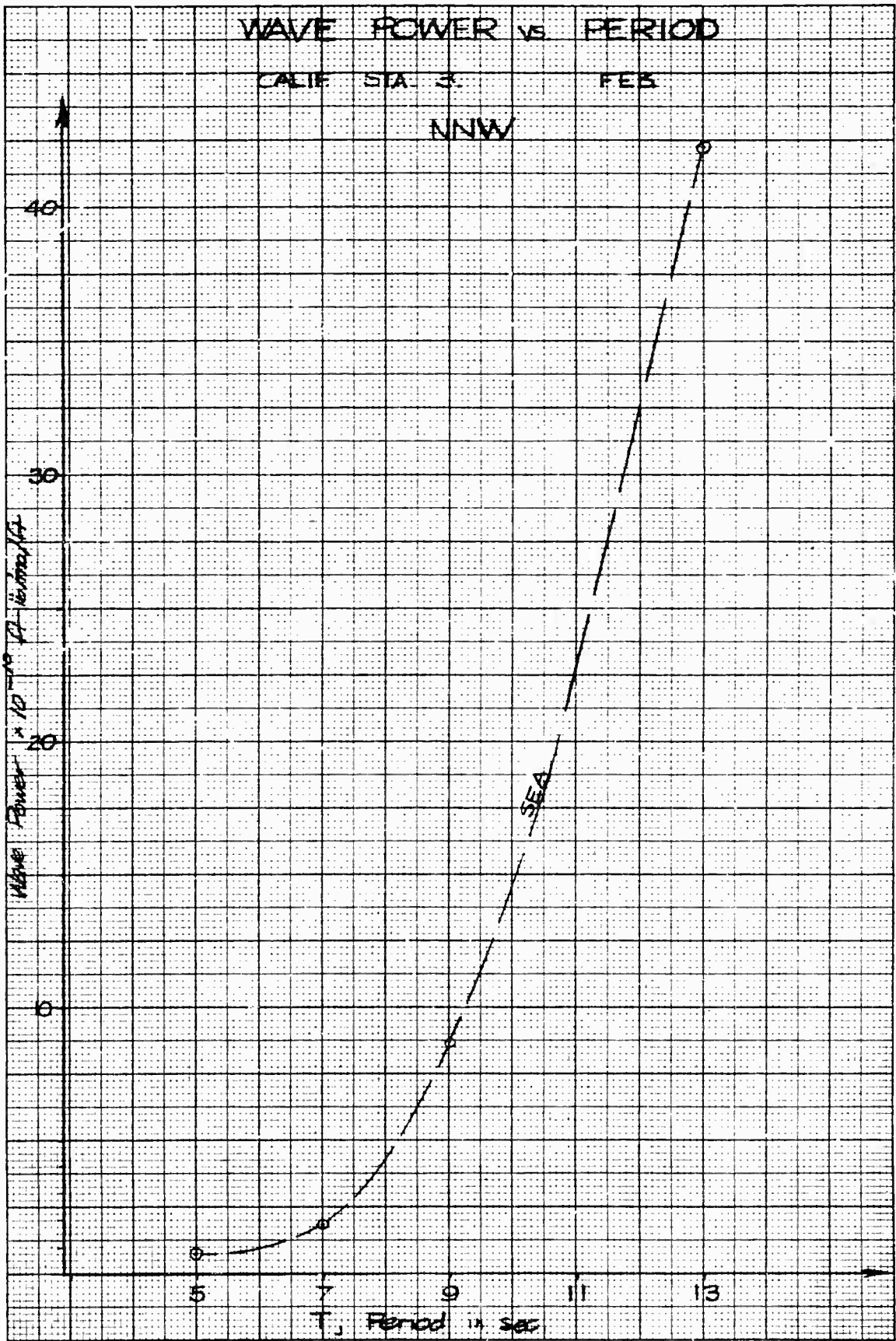
K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES 46 1323
KEUFFEL & ESCHER CO.

STATION 3 - FEBRUARY

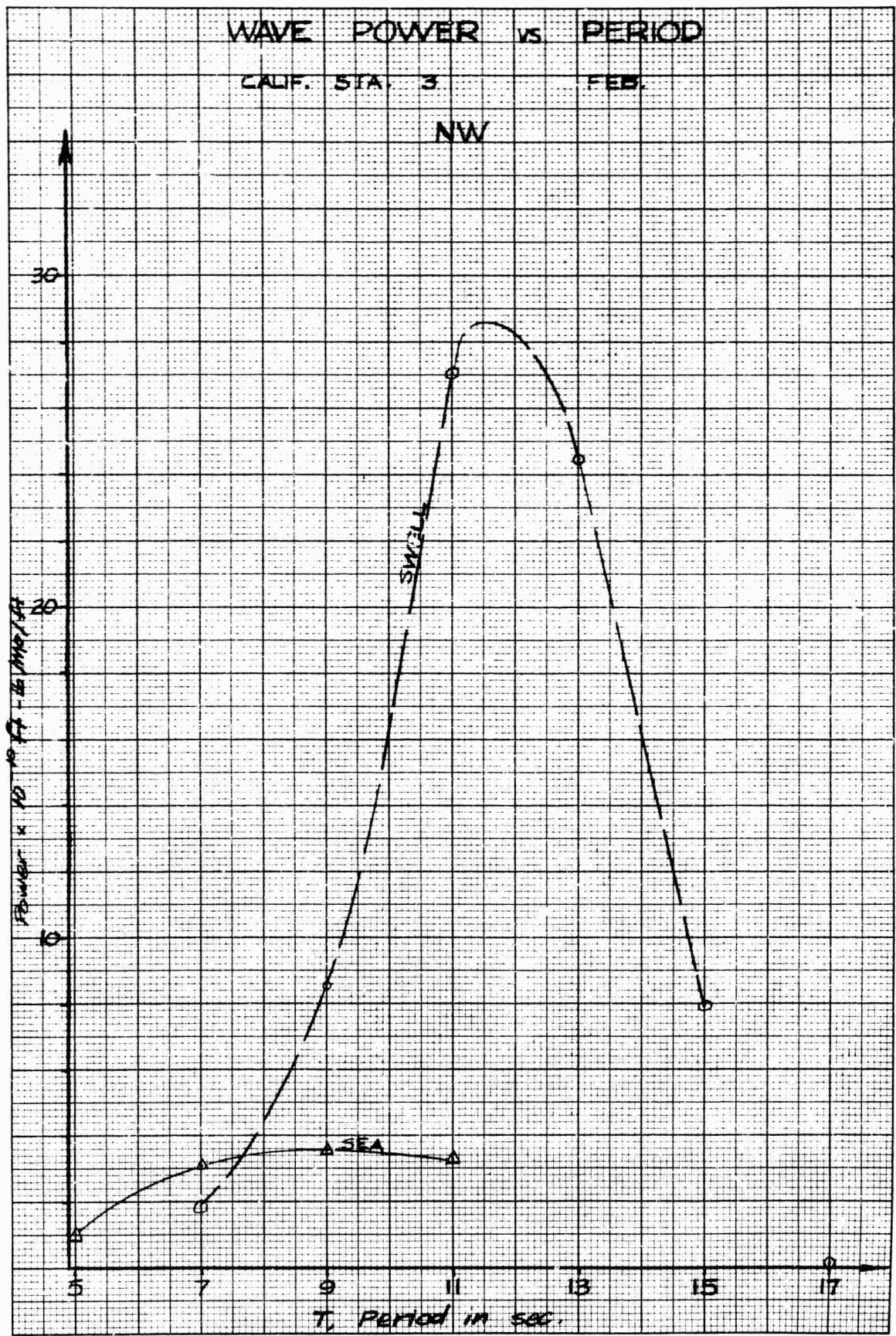
K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



K&E 10 X 10 TO 1 1/2 INCH 48 1323
1 X 10 INCHES
KEUFFEL & ESSER CO.



K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.

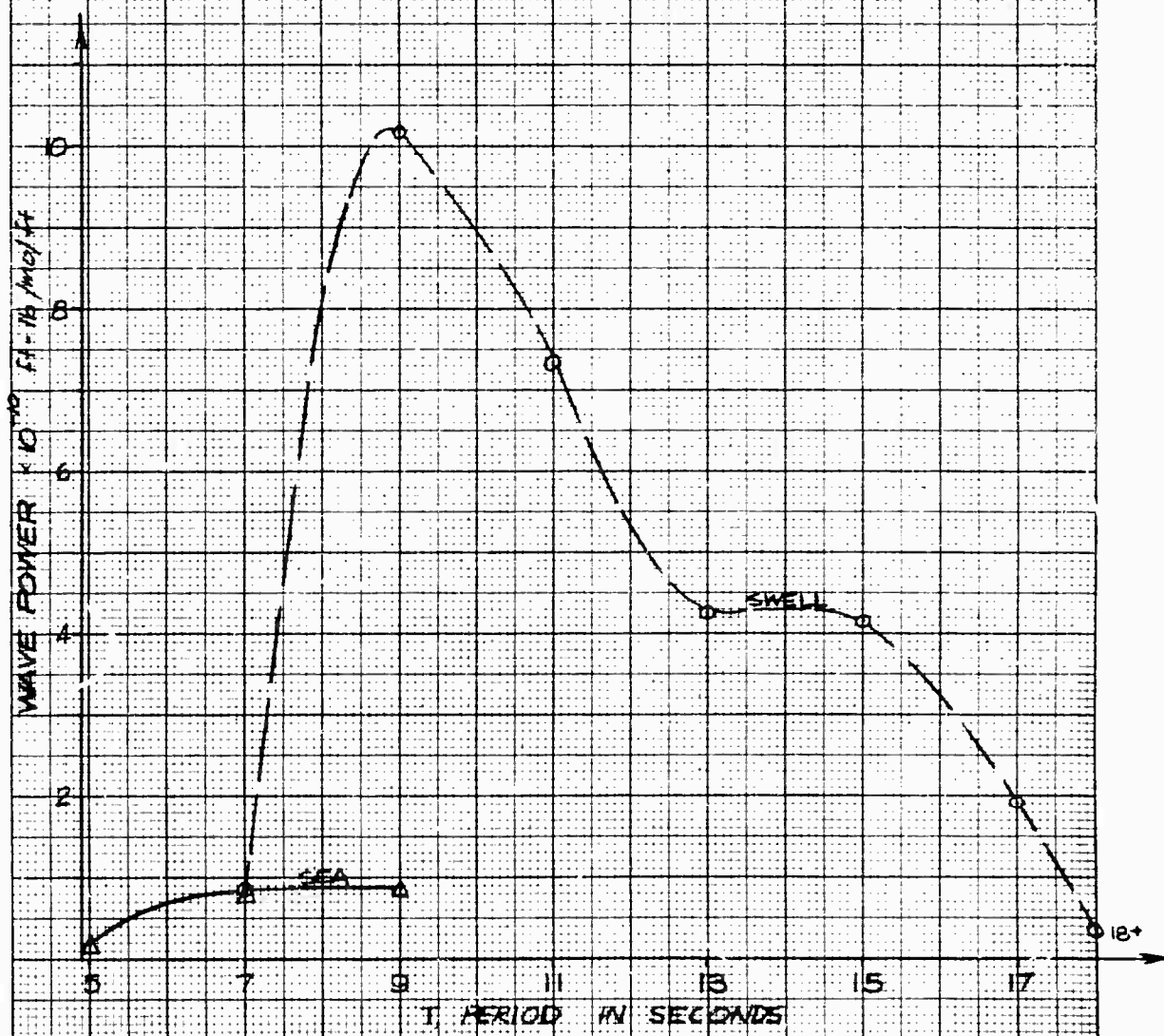


WAVE POWER VS PERIOD

CALIF. STA. 3

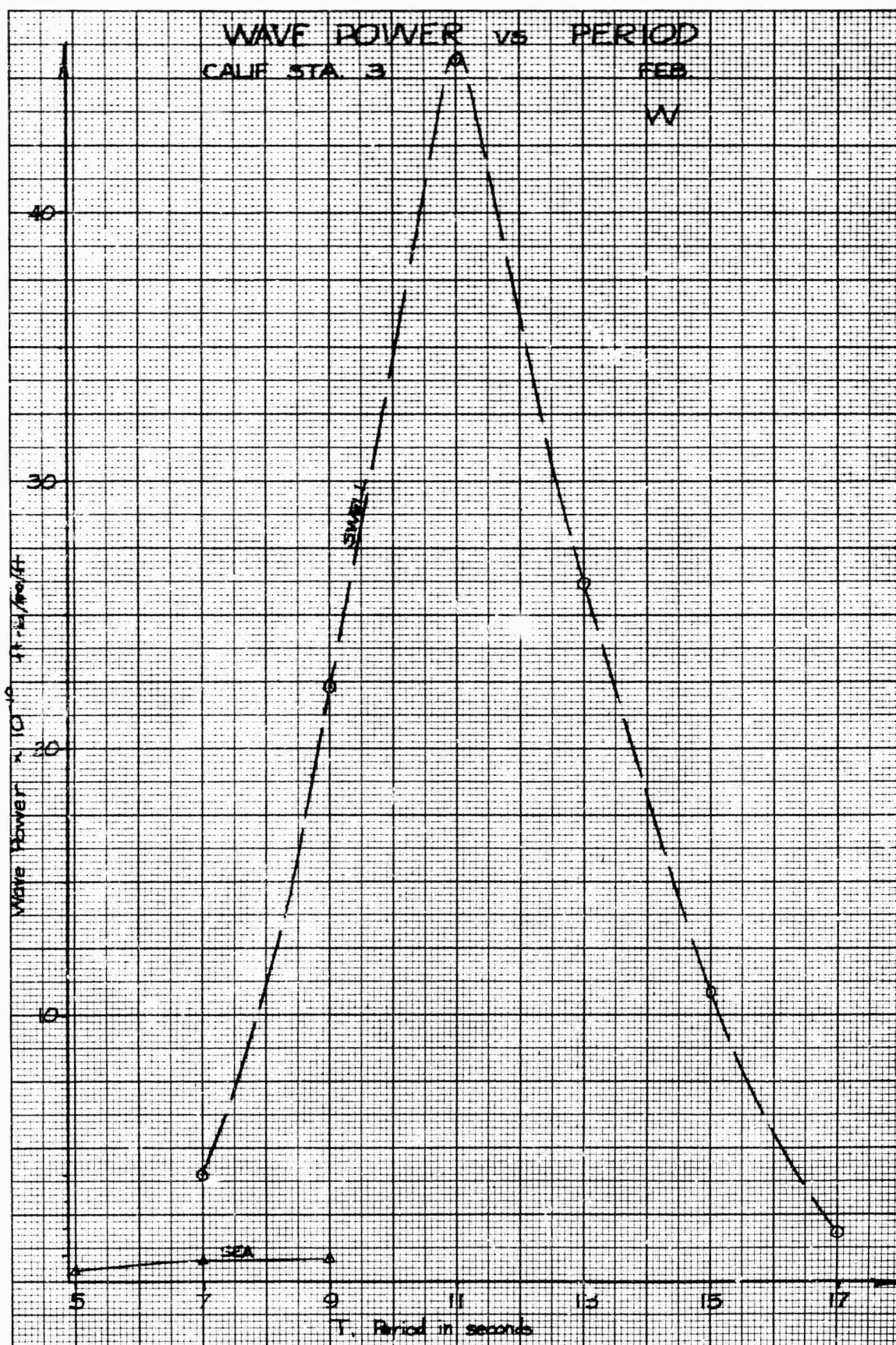
FEB.

WNW

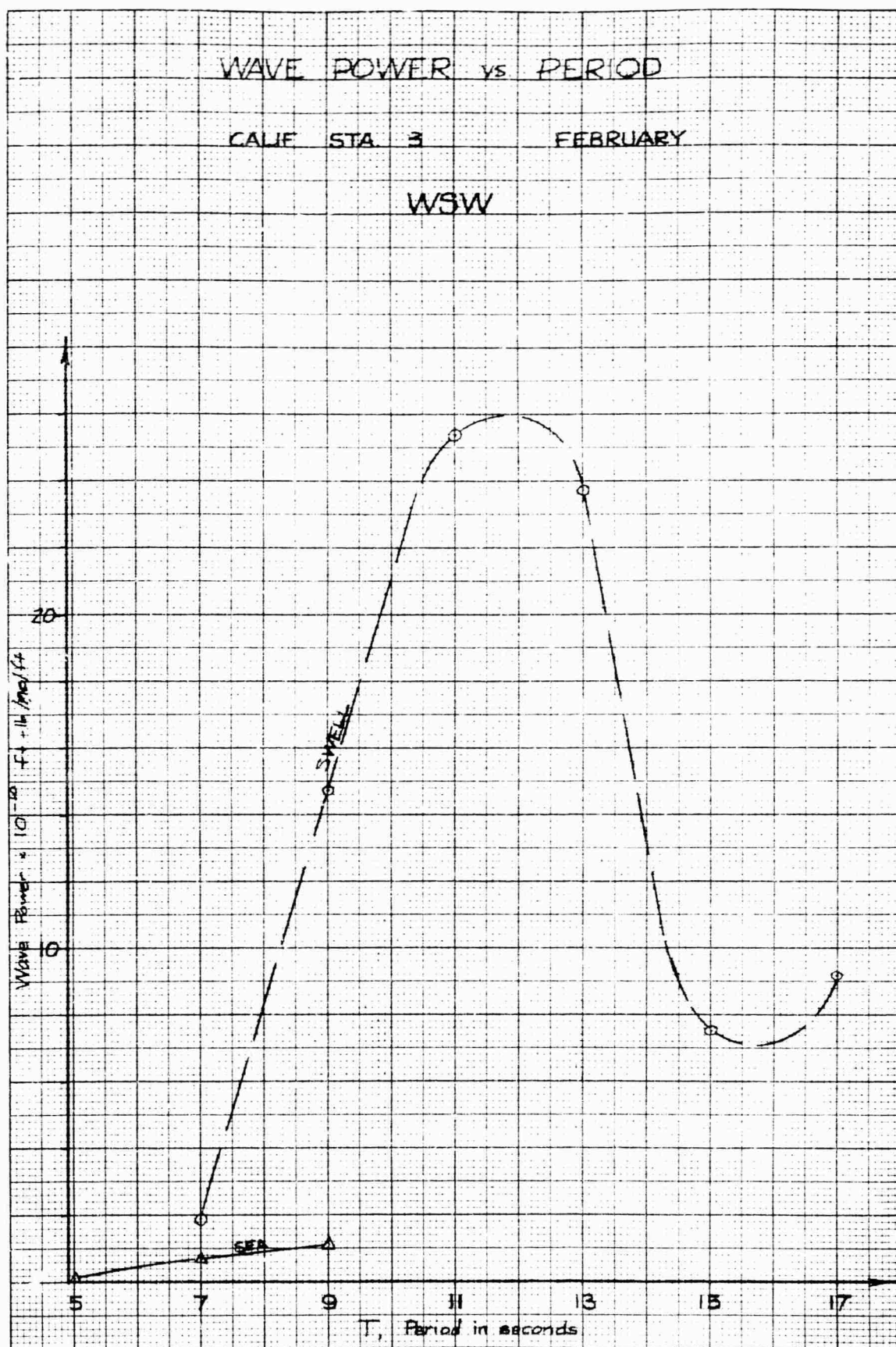


B-14

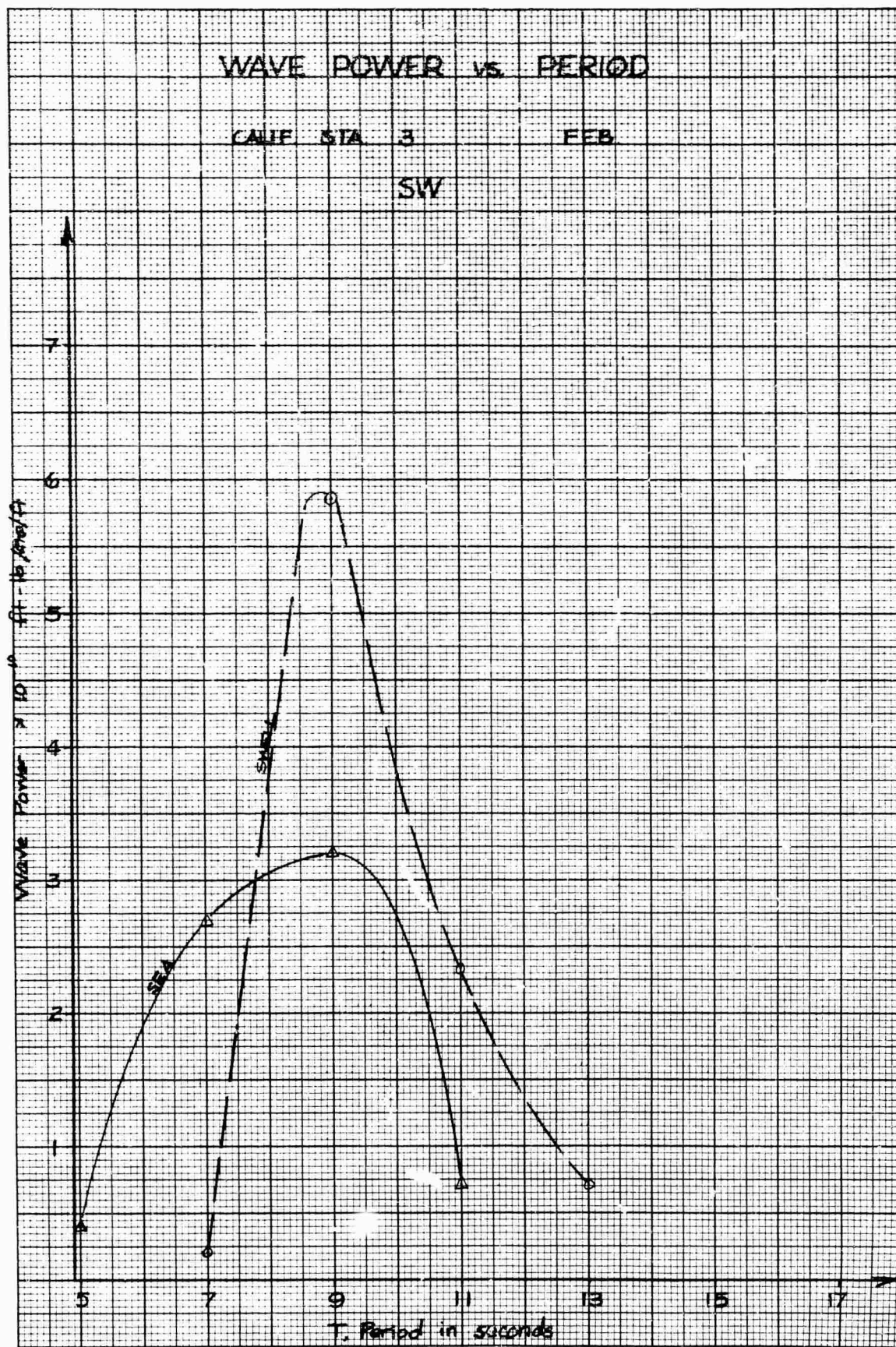
K-E 10 X 10 TO 1/2 INCH 46 1323
 1 X 10 INCHES 400 N U.S.A.
 KEUFFEL & ESSER CO.



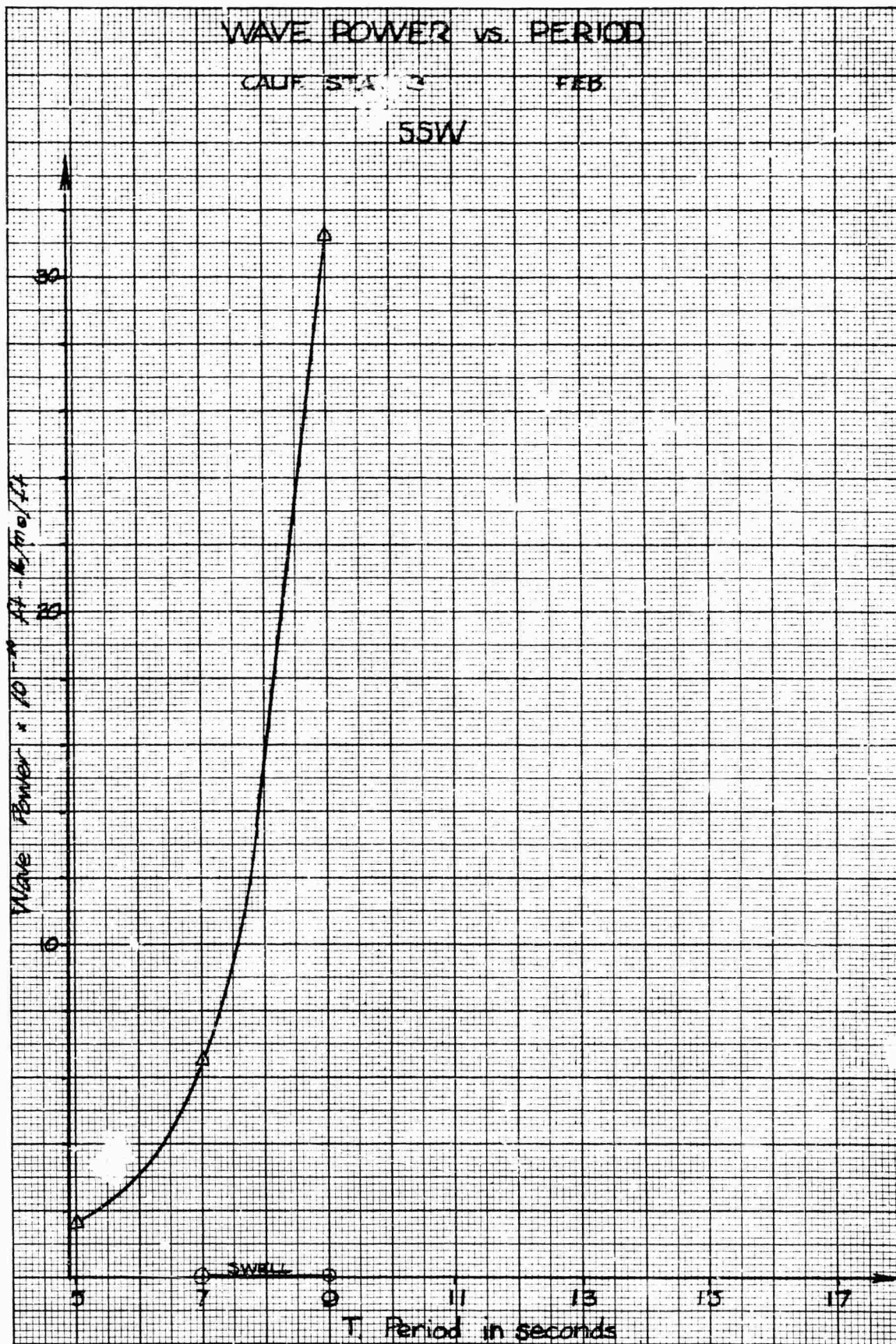
K&E 10 x 10 TO 1 1/2 INCH 46 1323
 2 x 1/2 INCHES MADE IN U.S.A.
 KEUFFEL & ESSER CO.



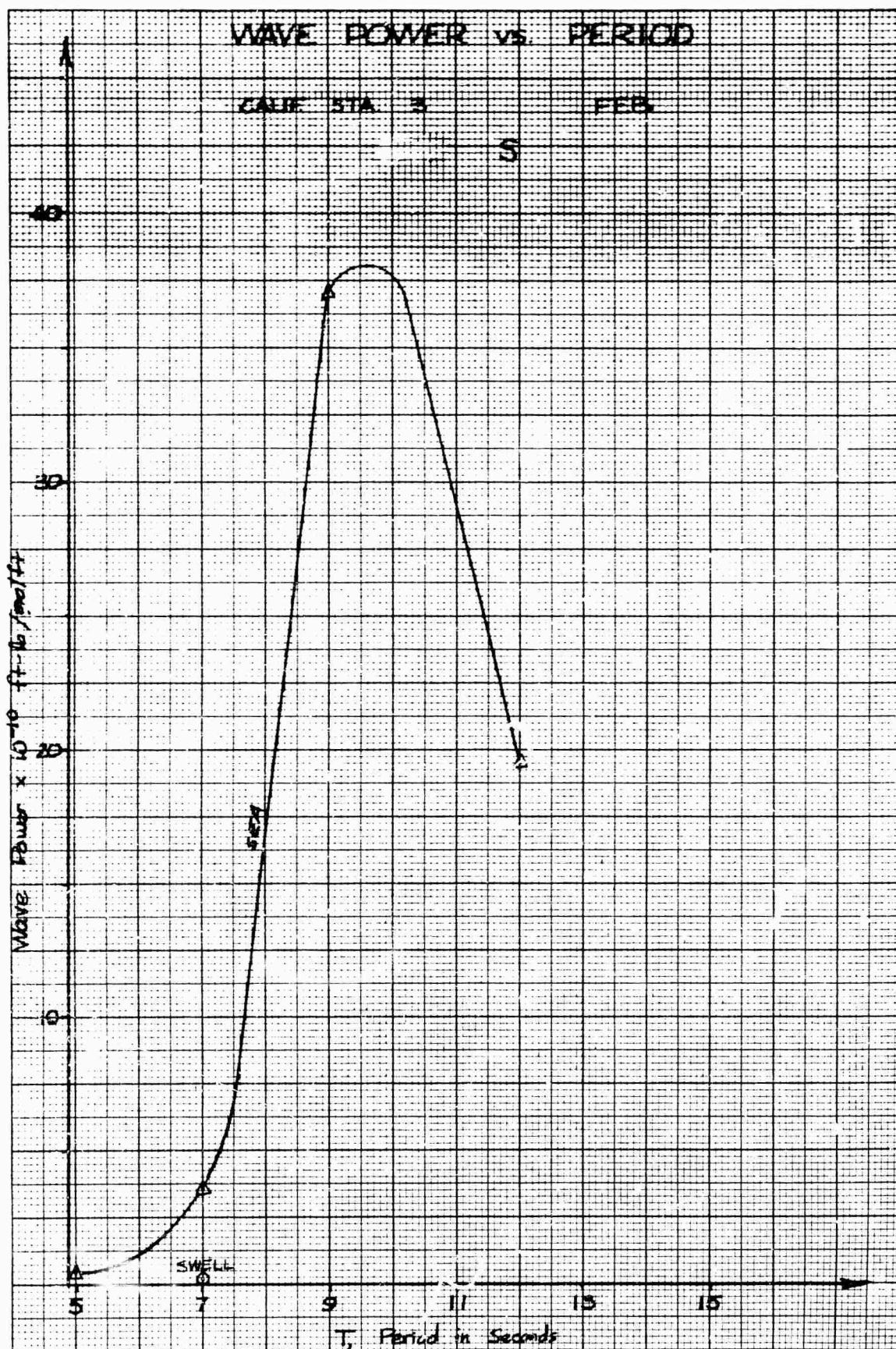
K&E 10 X 10 TO 1/2 INCH 46 1323
 7 X 10 INCHES MADE IN U.S.A.
 KEUFFEL & ESSER CO.



K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



1405 10 X 10 TO 1 INCH 46 1323
 REUPPEL & SONS, INC.

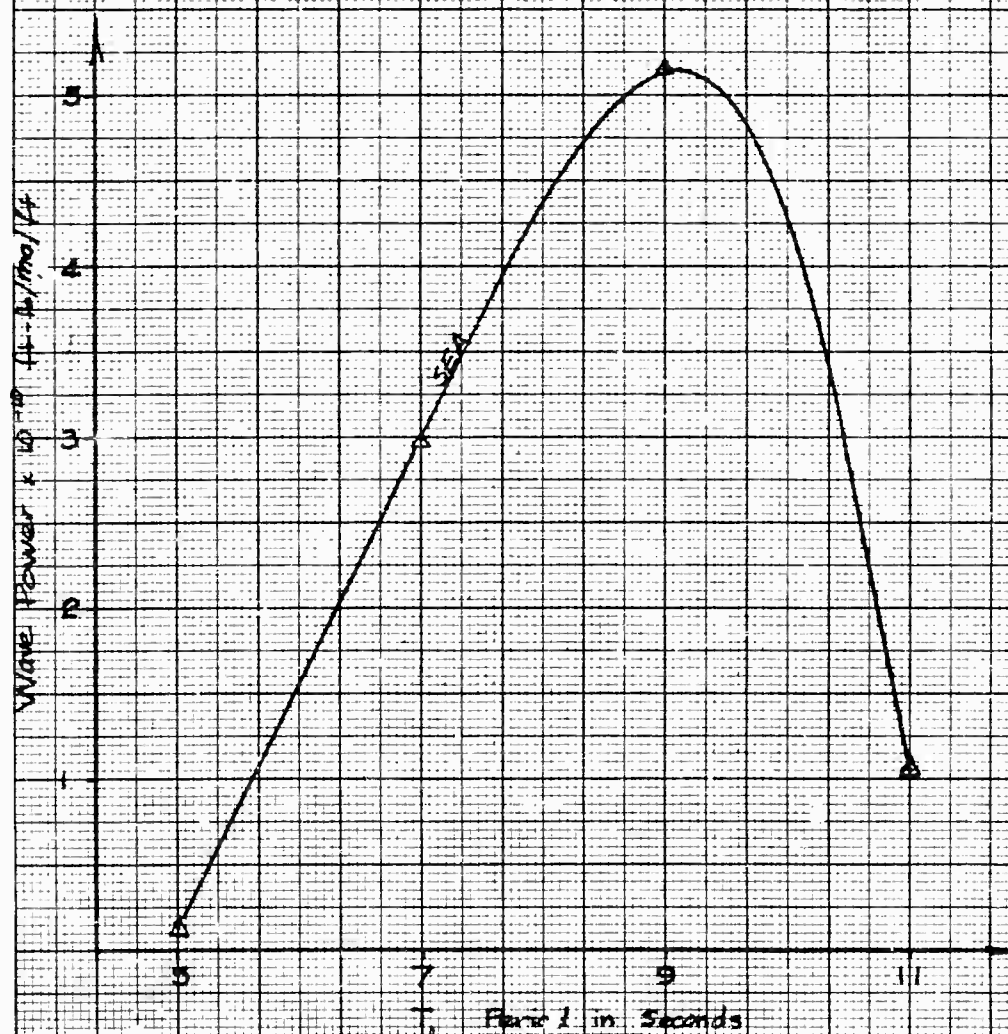


WAVE POWER vs PERIOD

CAUF STA. 3

FEB

SSE



K&E 10 x 10 TO 1 1/2 INCH 46 1323
 MADE IN U.S.A.
 NEUFFEL & ESSLER CO.

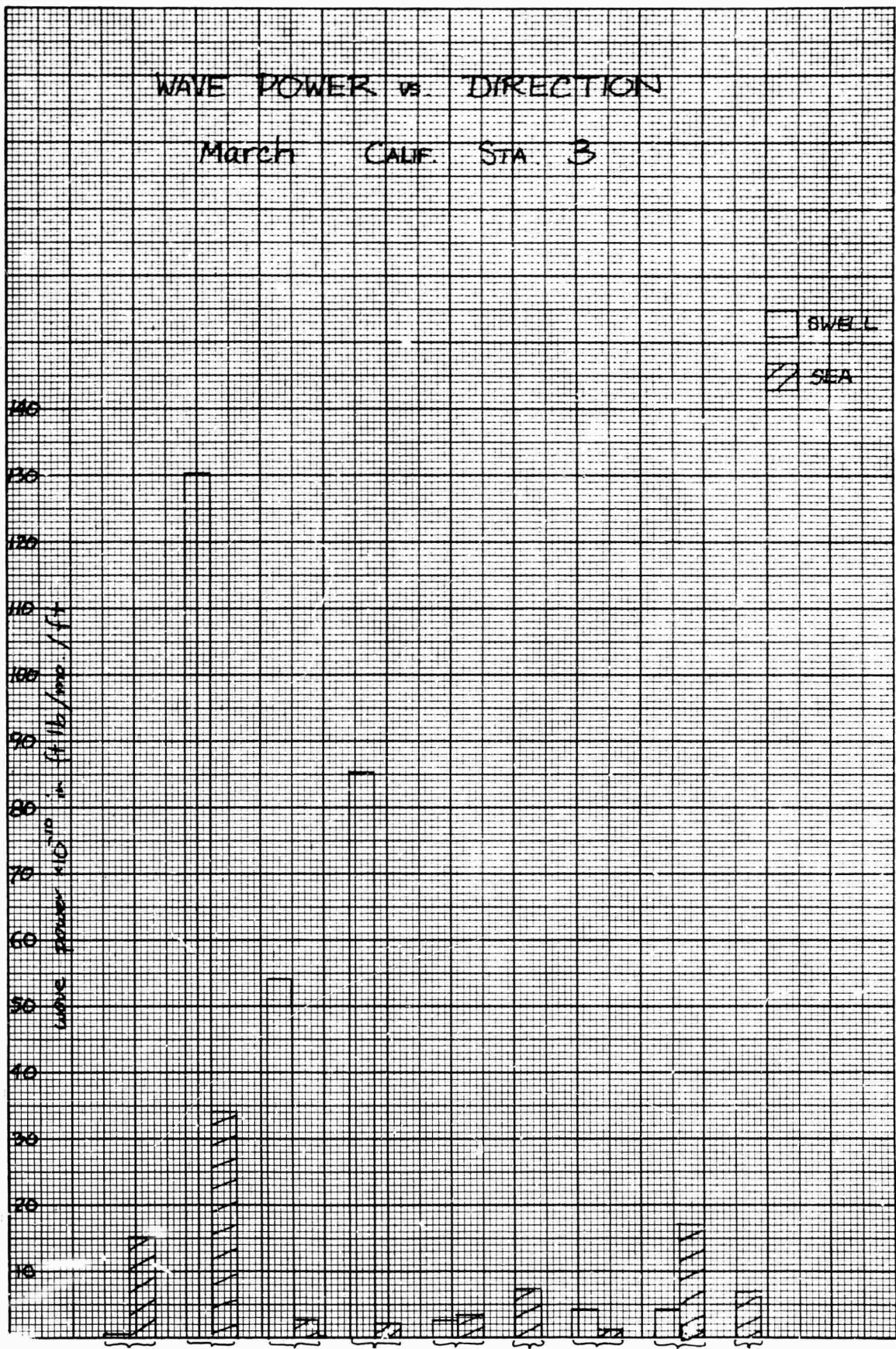
STATION 3 - MARCH

WAVE POWER vs. DIRECTION

March CALIF. STA. 3

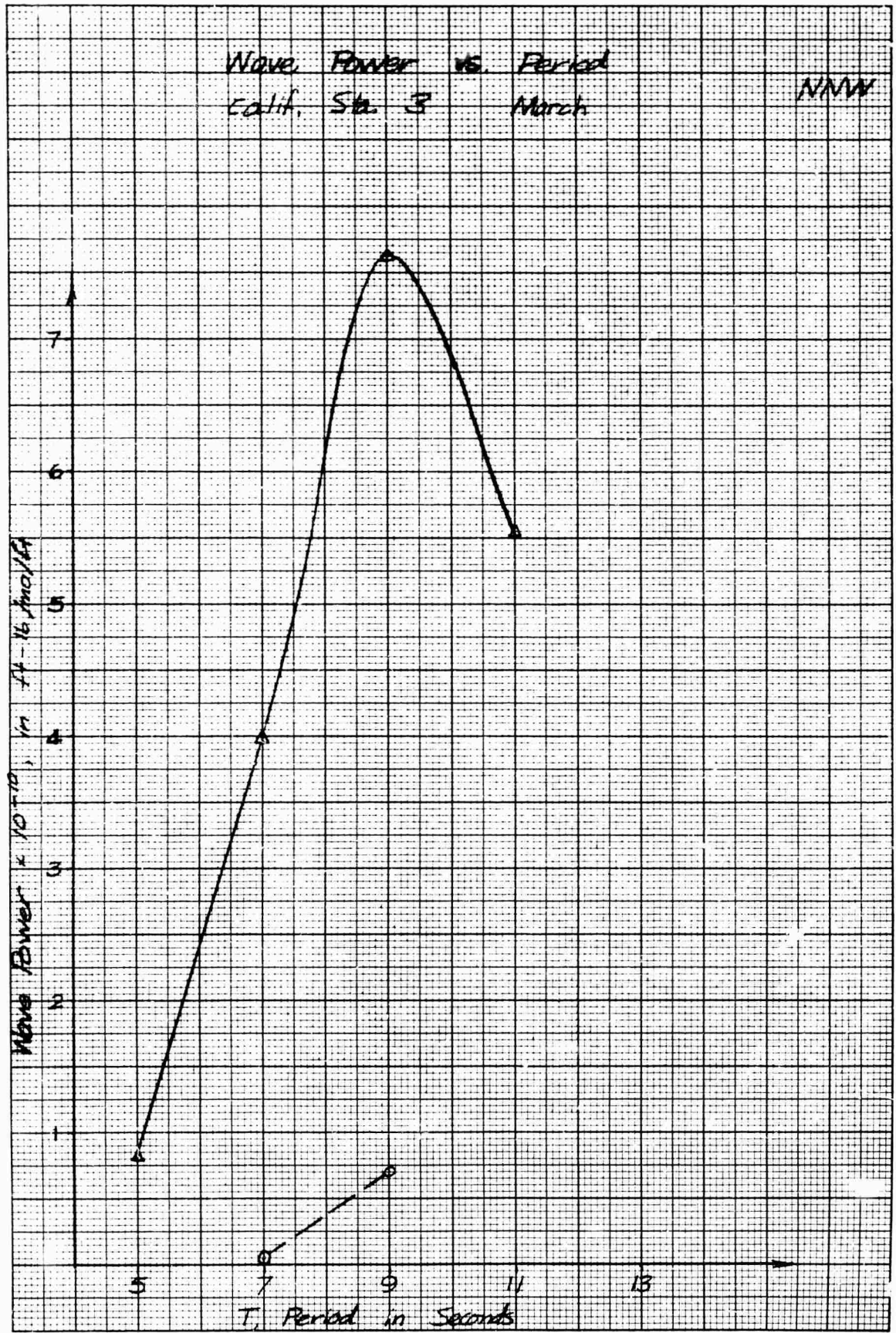
SWELL
SEA

Wave power $\times 10^{10}$ in ft/lb/mo/ft

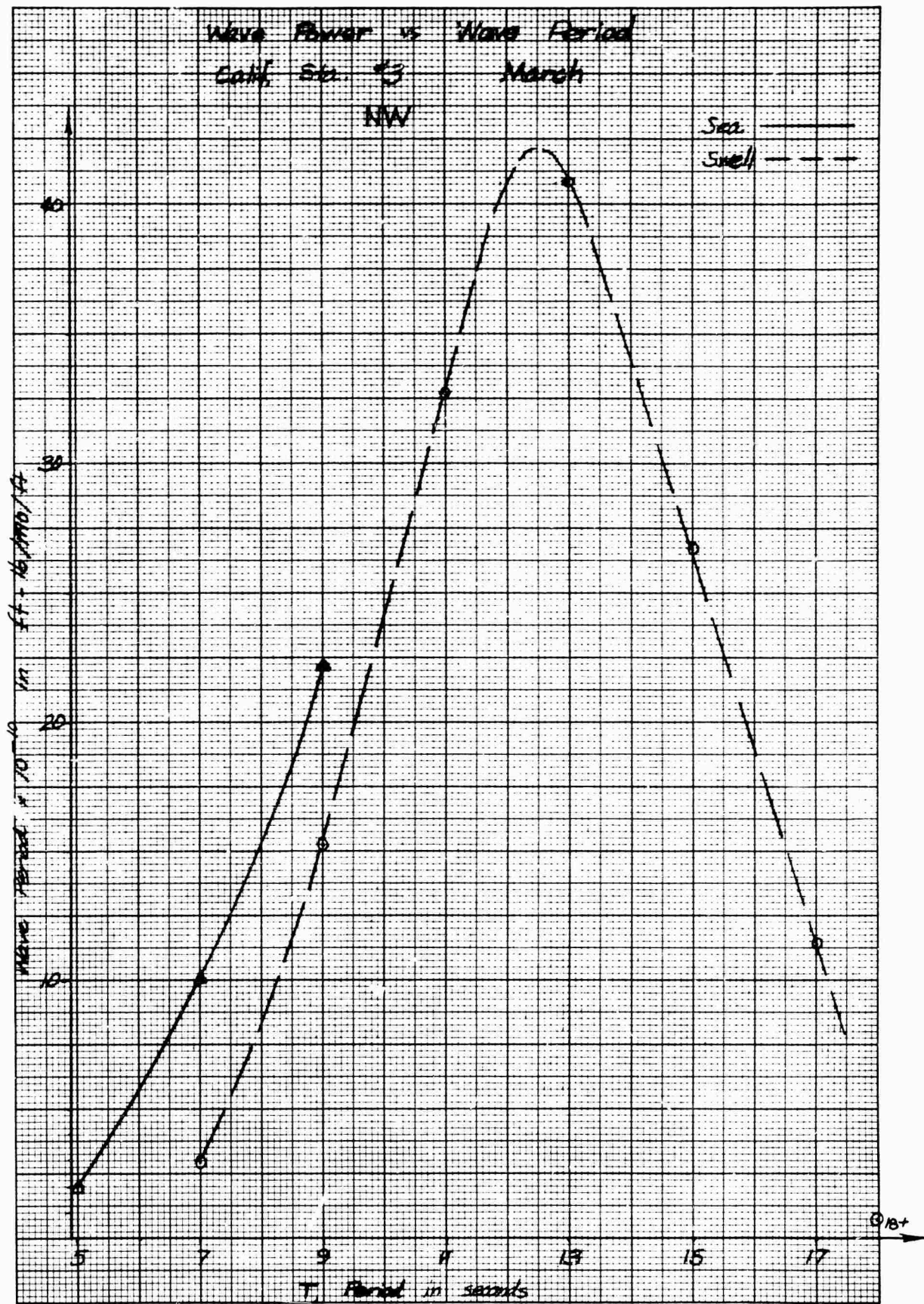


K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

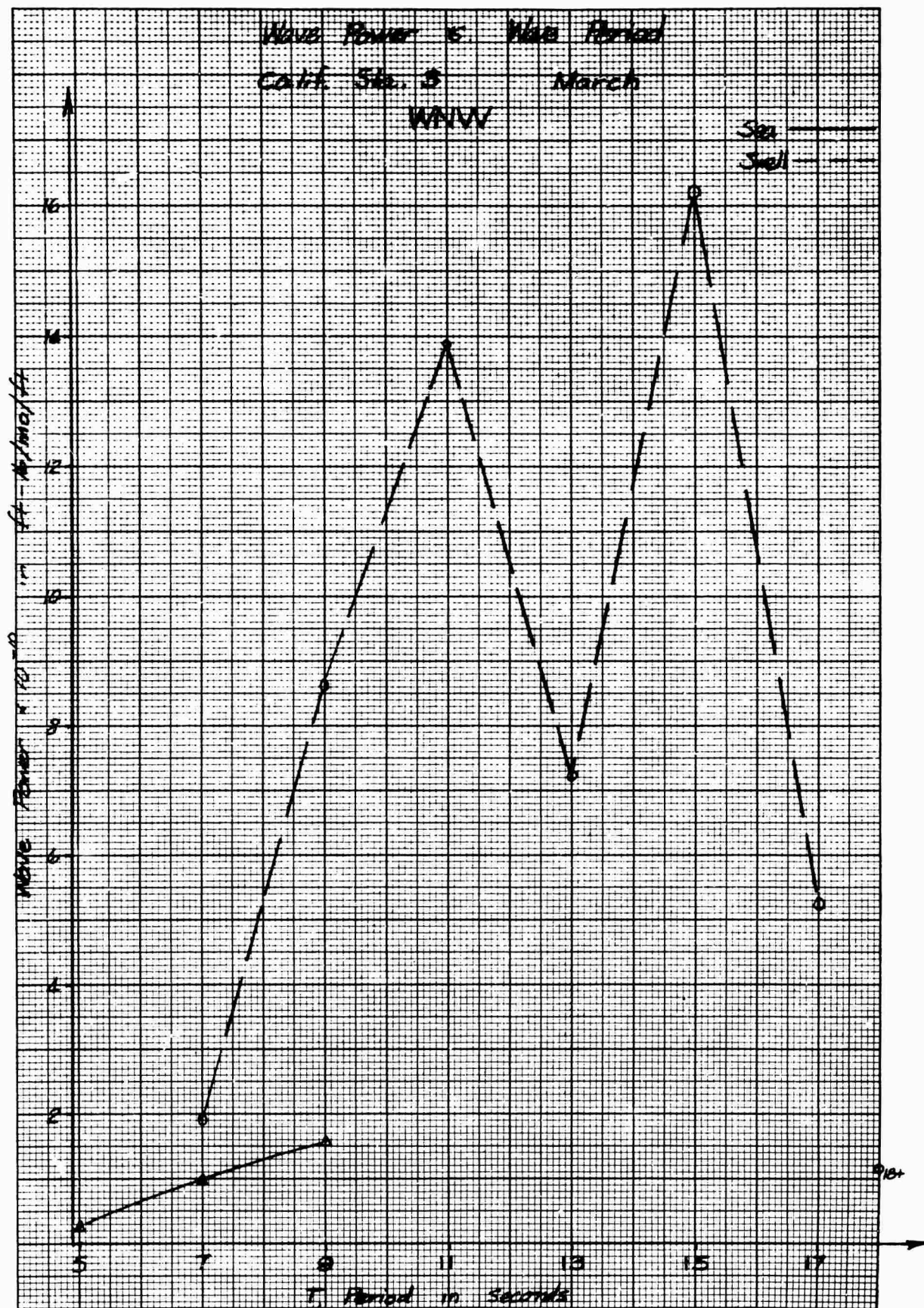
K&E 10 X 10 TO 1/2 INCH 46 1323
MADE IN U.S.A.
KEUFFEL & ESSER CO



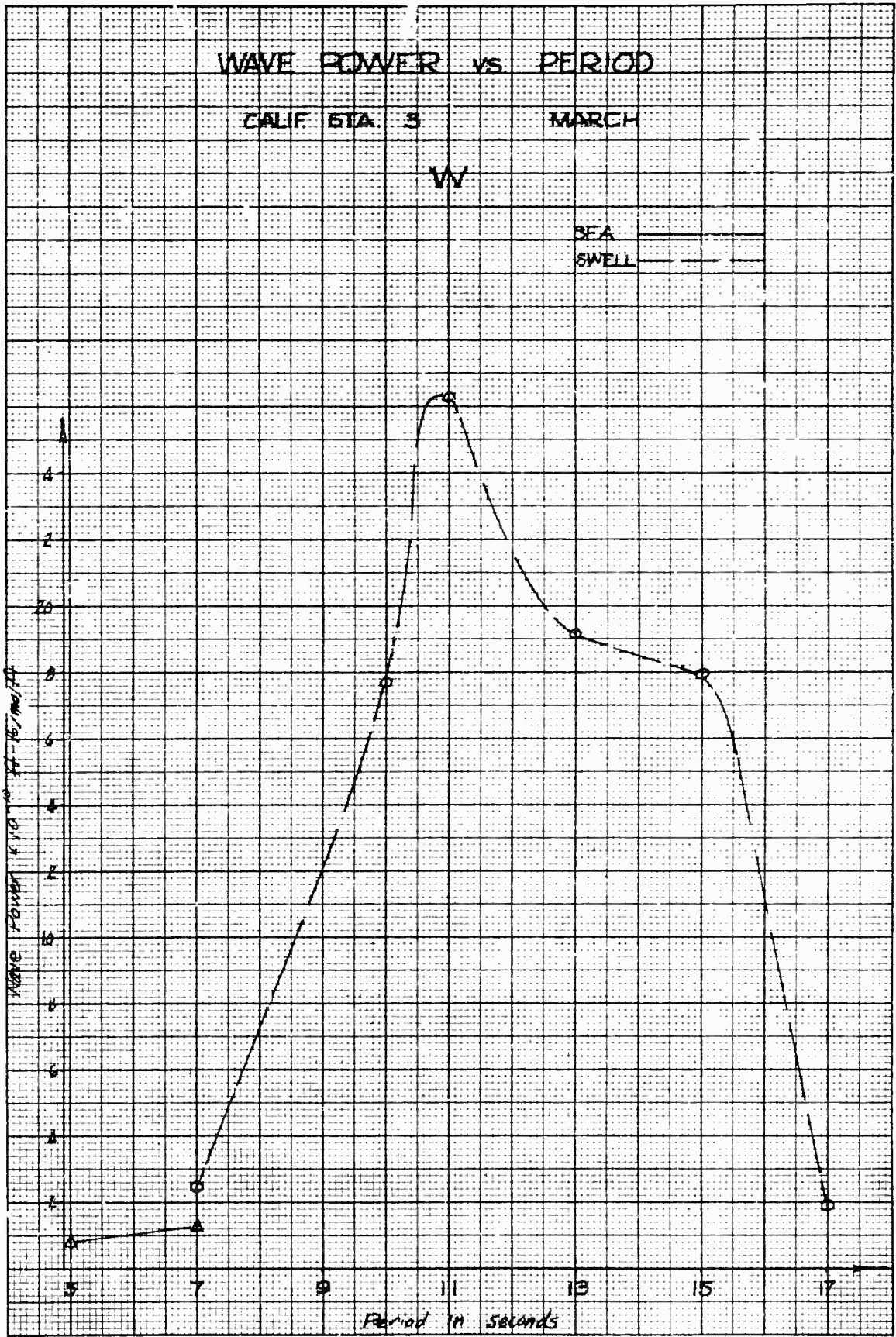
K&E 10 X 10 TO 1 1/2 INCH 46 1323
MADE IN U.S.A.
KEUFFEL & ESSLER CO.



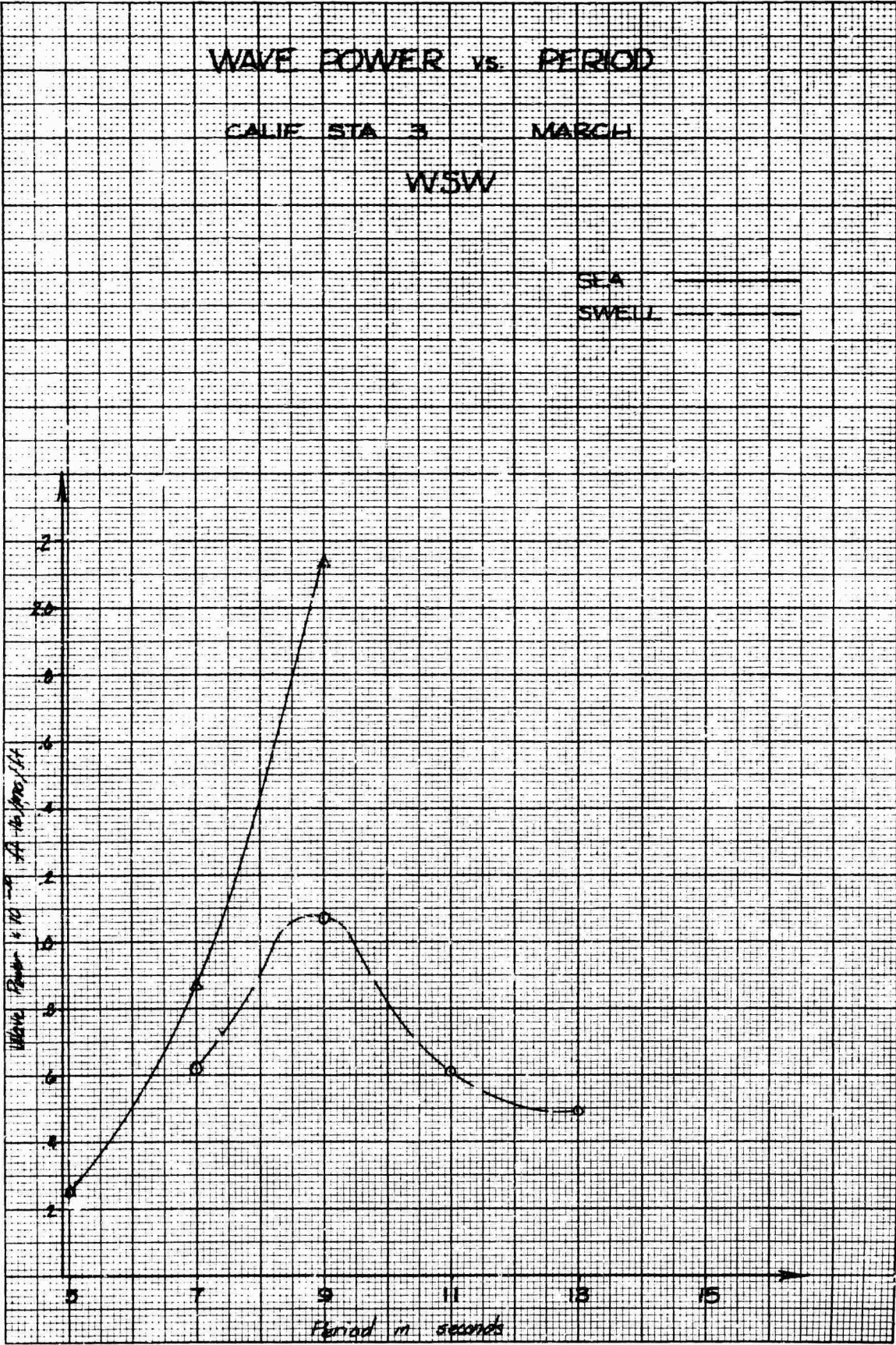
K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



K₀Σ 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



K₀Σ 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
GEUFFEL & ESSEN CO.



WAVE POWER vs PERIOD

CAUSE SEA 3

MARCH

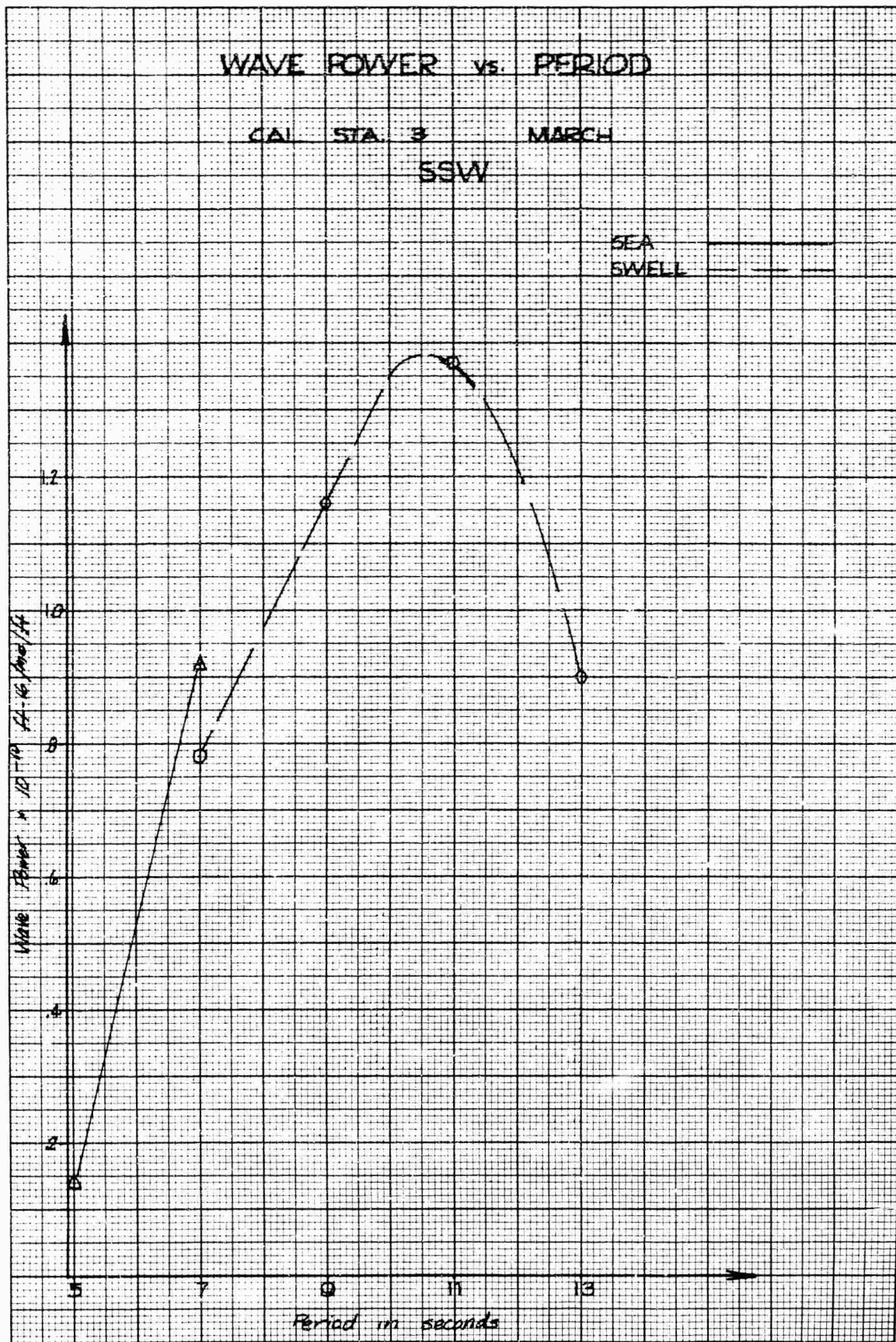
SW

SEA

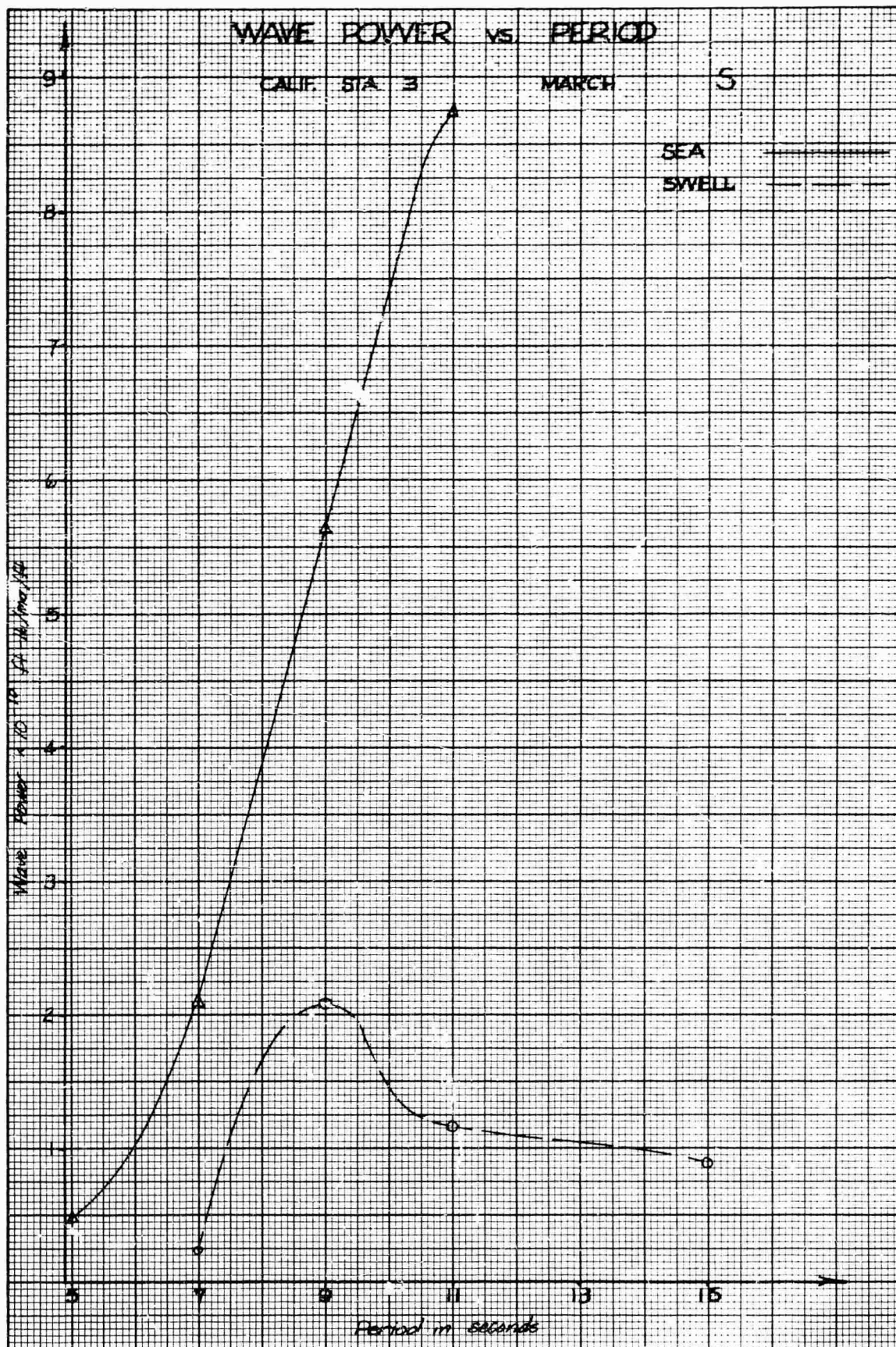


K-Σ 10 X 10 TO 1/2 INCH 46 1323
 MADE IN U.S.A.
 KRUEFFEL & ESSCK CO.

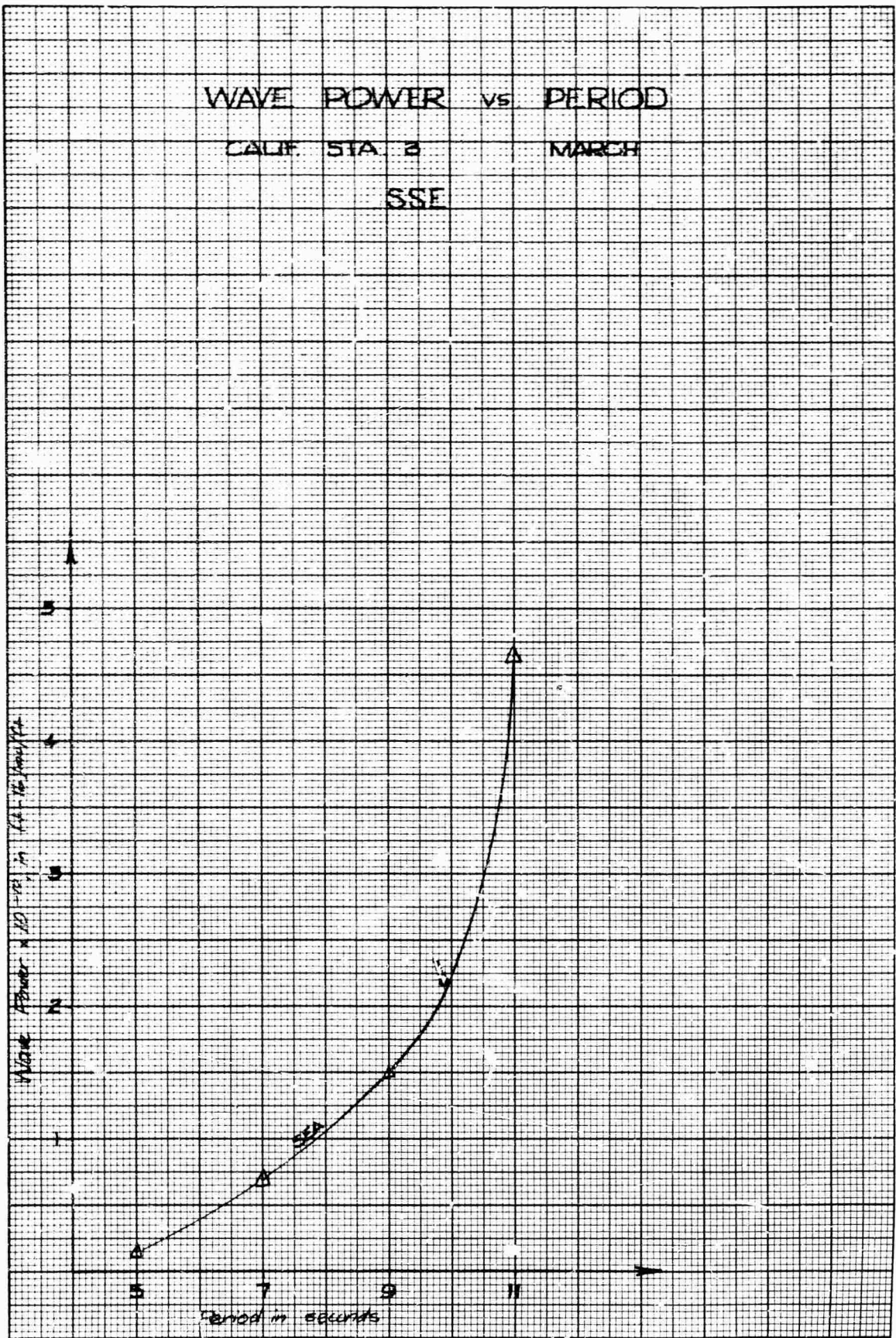
K&E 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



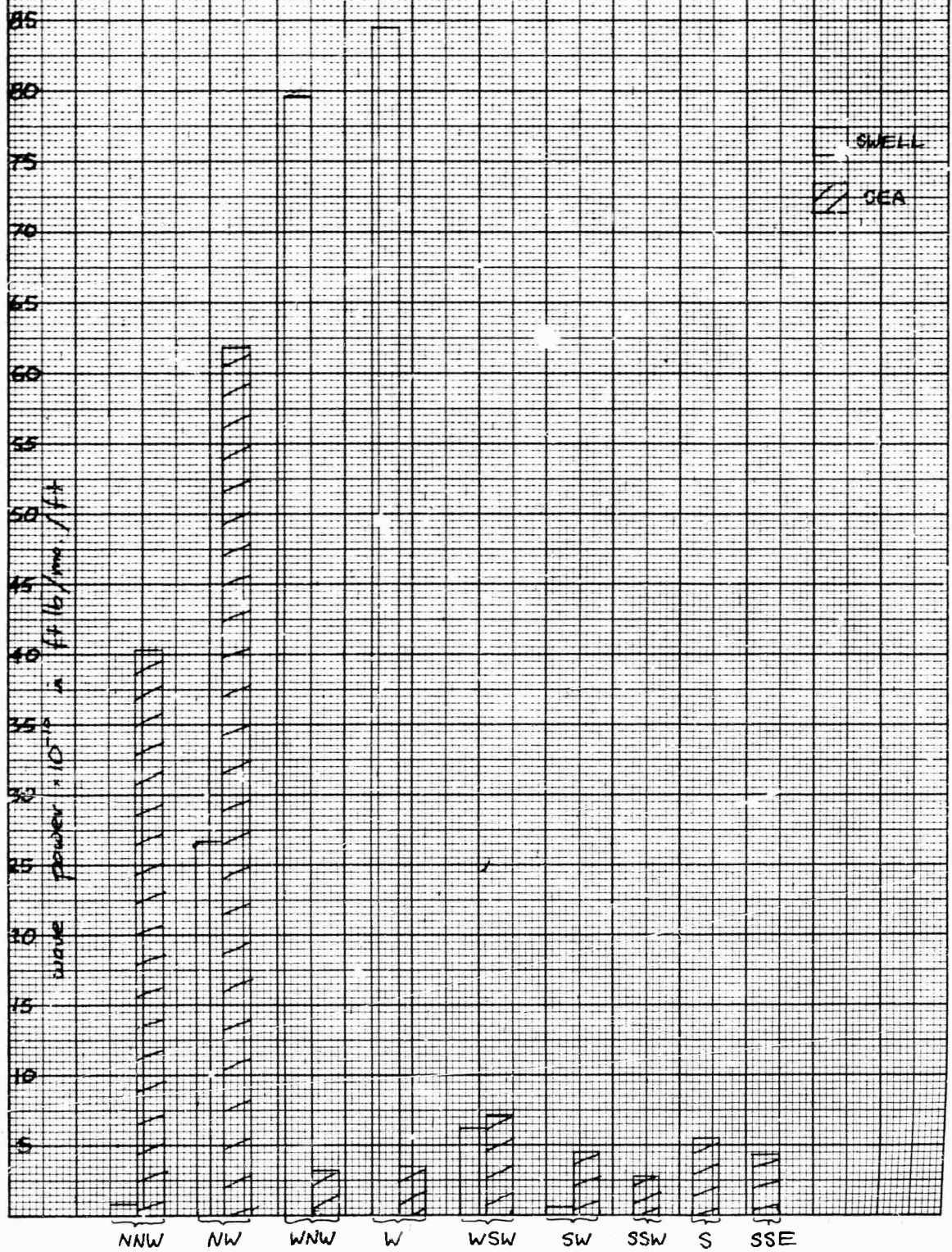
K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.



STATION 3 - APRIL

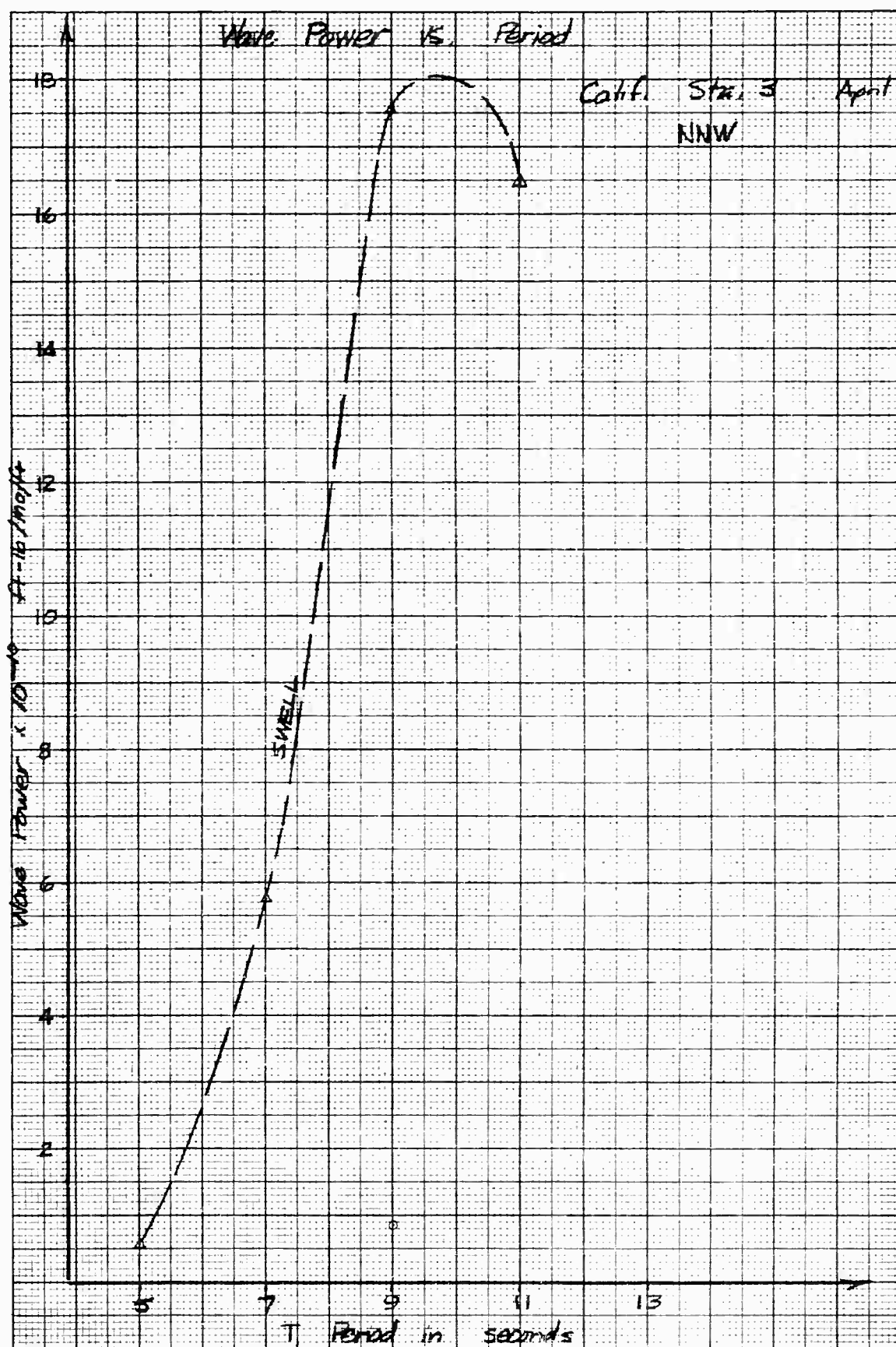
WAVE POWER vs. DIRECTION

April CALIF. STA. 3

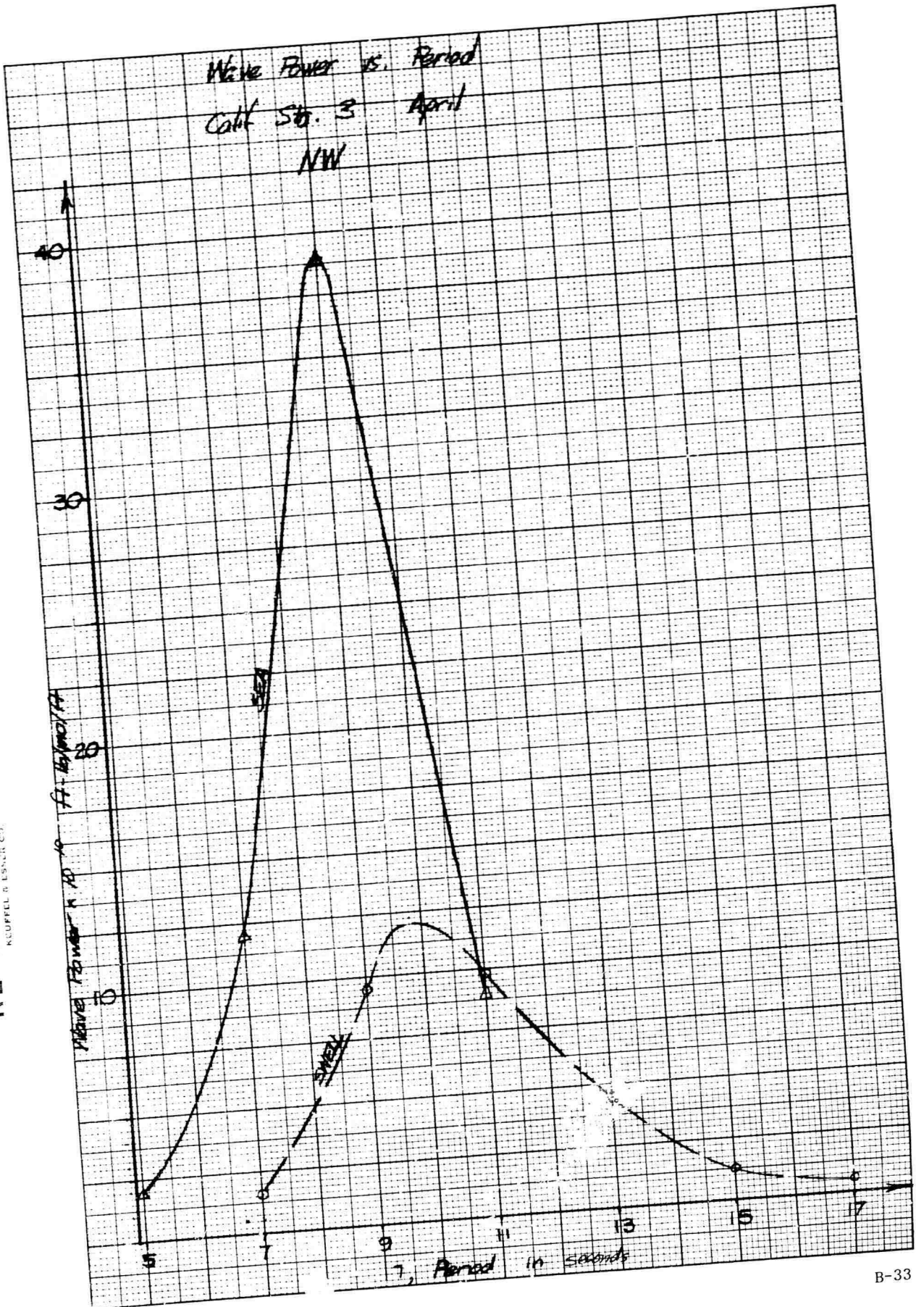


K-E 10 X 10 TO 1/2 INCH 48 1323
 7 X 10 INCHES
 MADE IN U.S.A.
 KEUFFEL & ESSER CO.

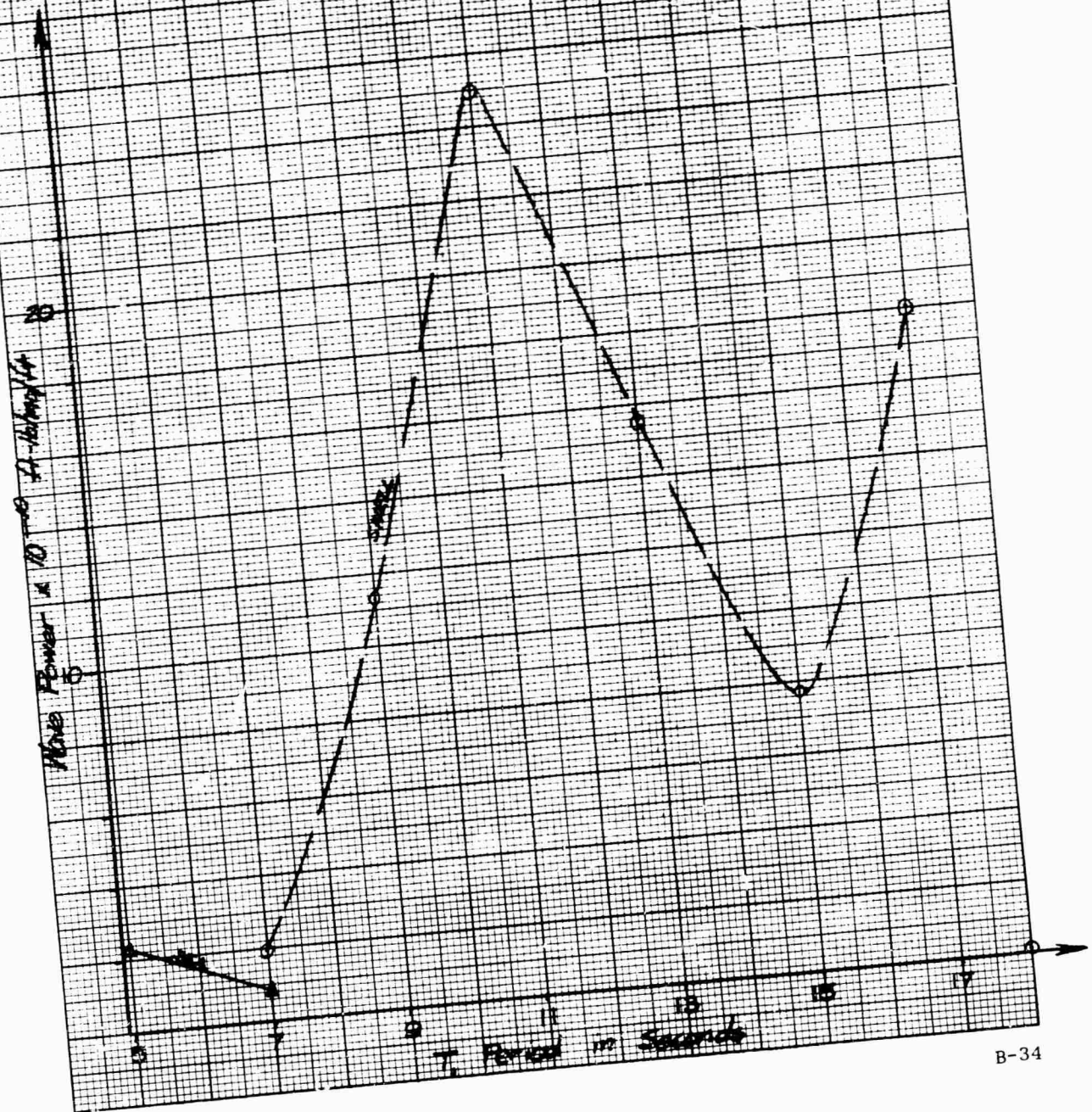
K&E 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.



K&E
10 x 10 TO 1/2 INCH 46 1323
K&E ENGINEERING
K&E ENGINEERING CO.

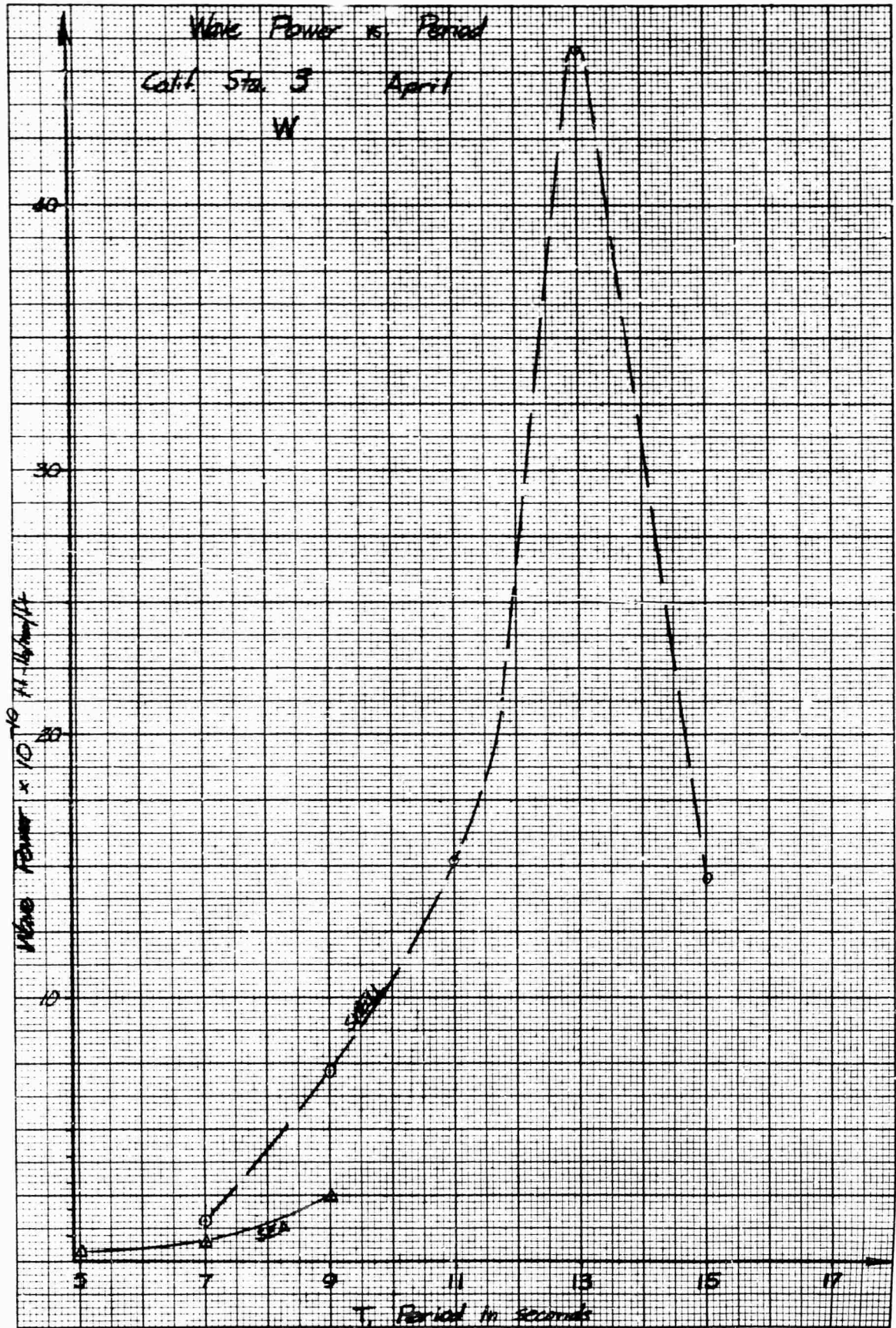


Wave Power vs Wave Period
 Coll. Sta. 3 April
 WNW

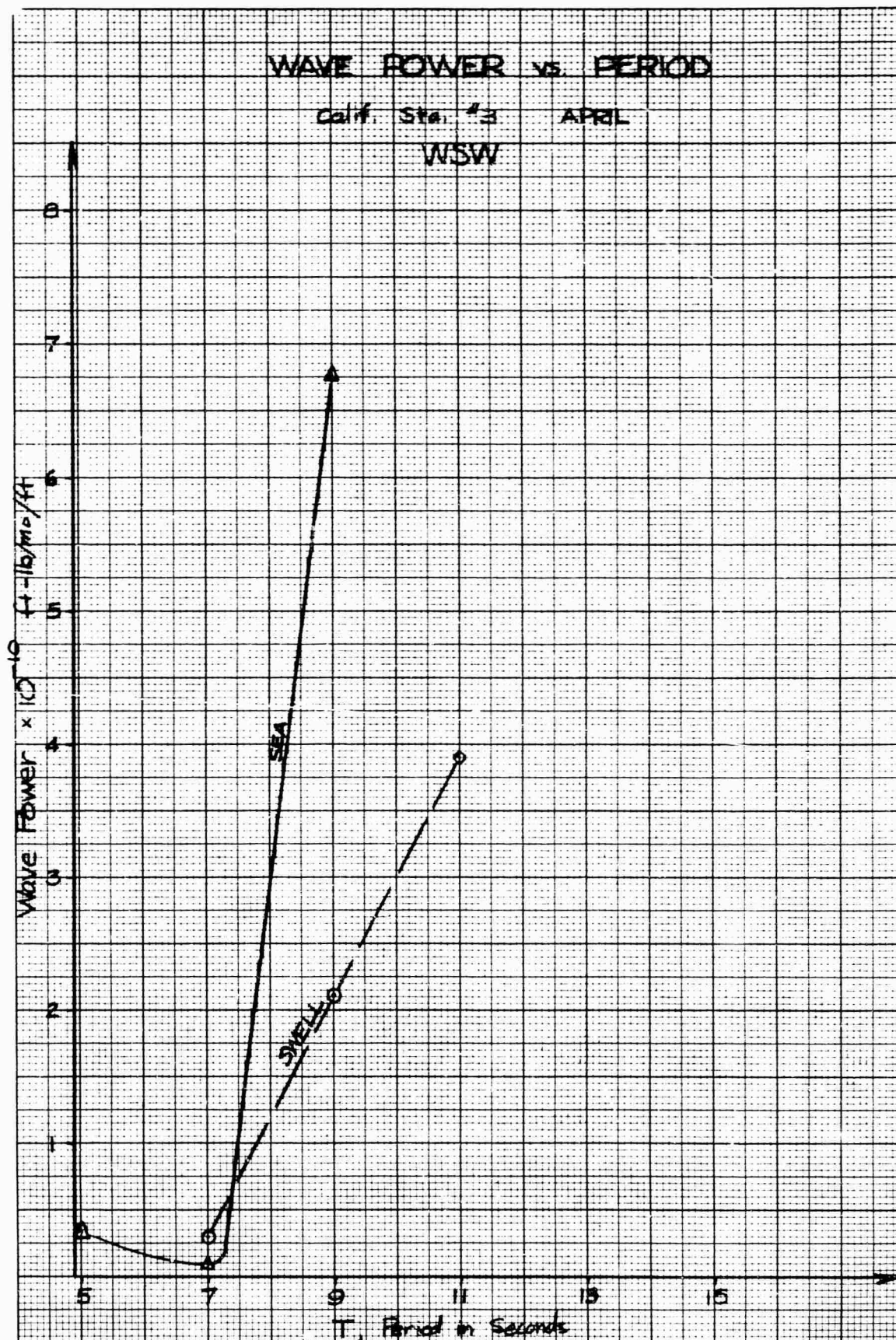


KE 10 X 10 TO 1 1/2 INCH 46 1323
 MADE IN U.S.A.
 KEUFFEL & ESSER CO.

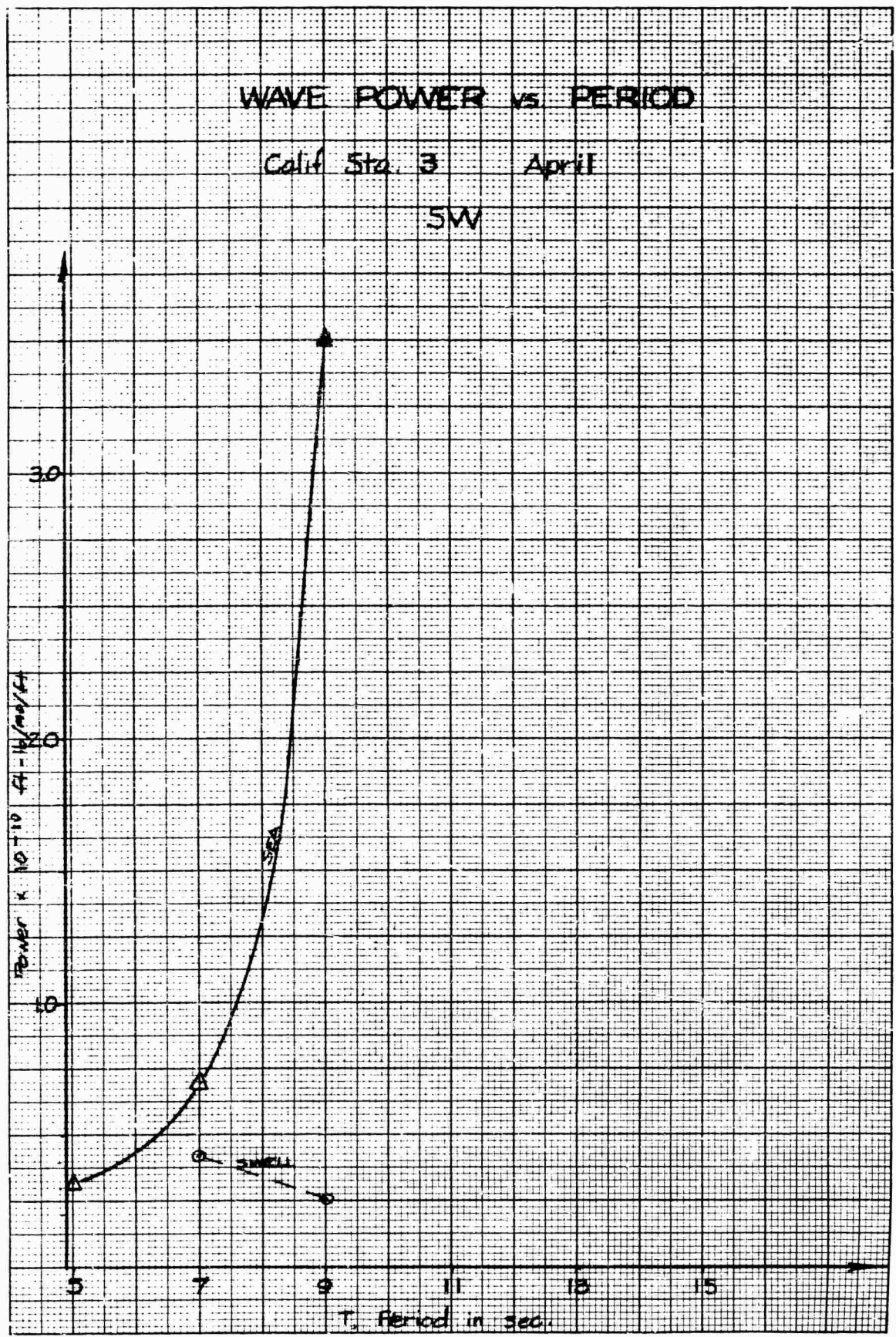
K&S 10 X 10 TO 1 1/2 INCH 46 1323
 KEUFFEL & ESSER CO.



K&E 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSECK CO.



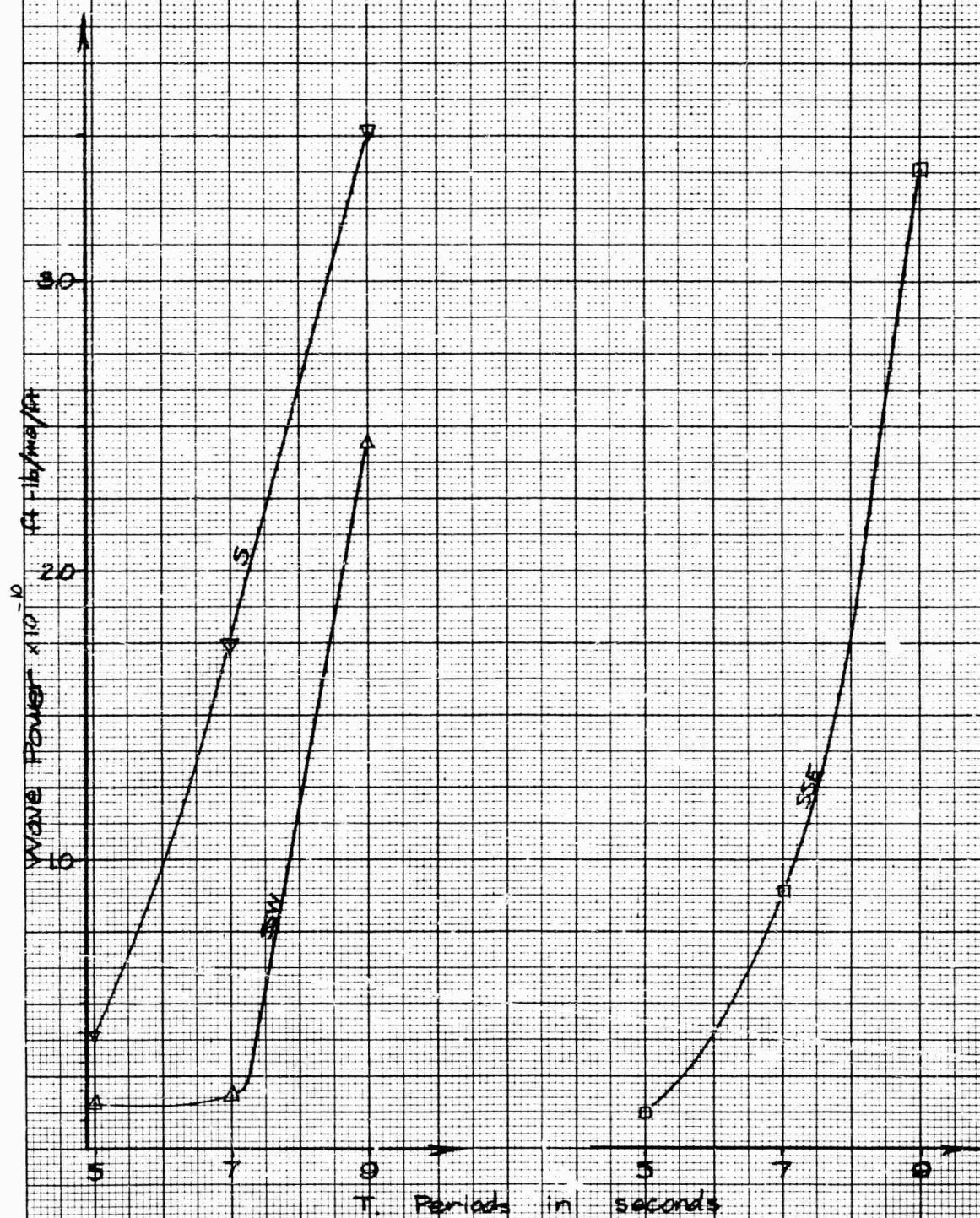
K&E 10 X 10 TO 1 1/2 INCH 46 1323
CALIF. U.S.A.
KUEFFEL & EPPNER CO.



WAVE POWER vs. PERIOD

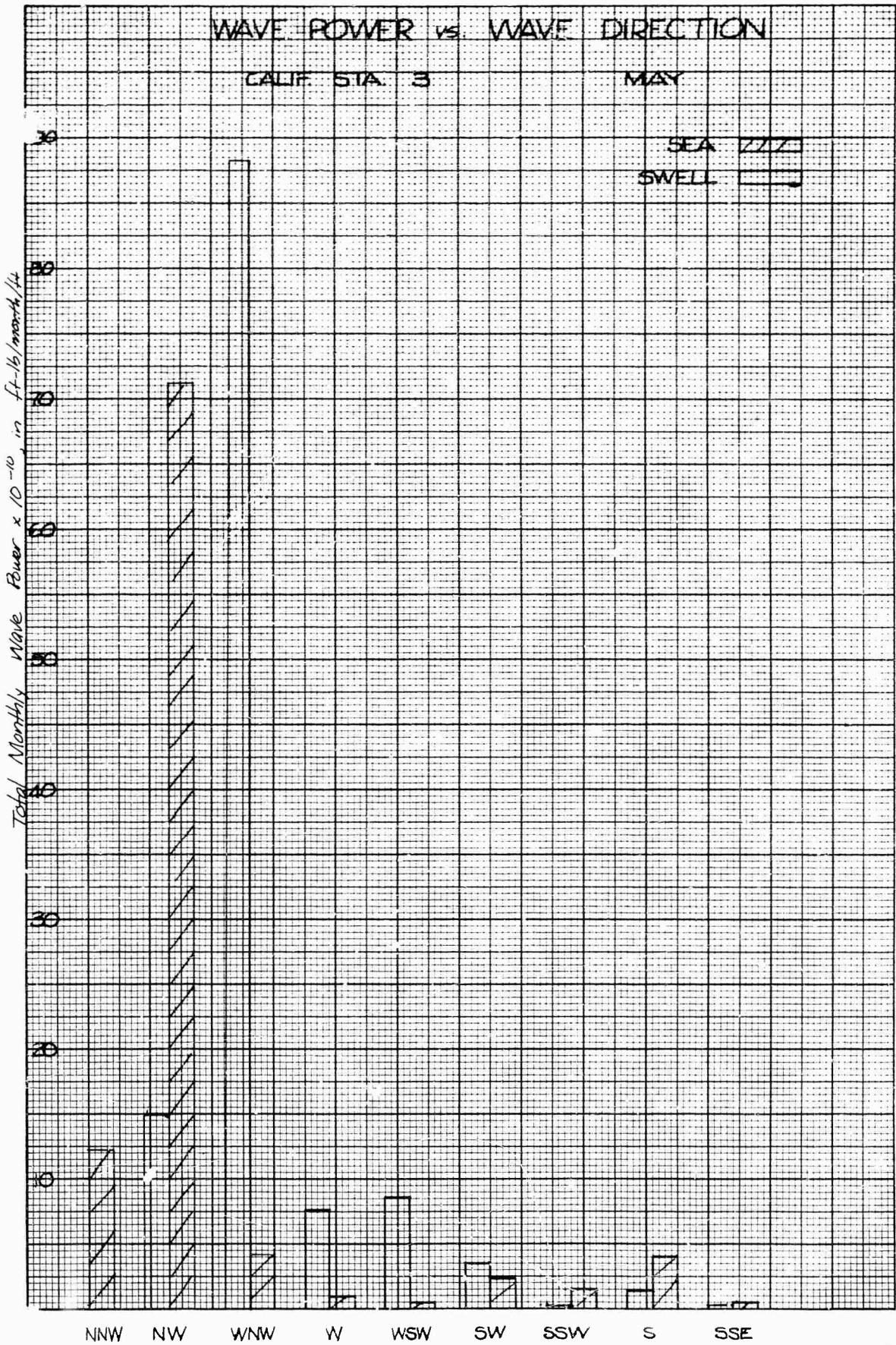
Coif Sta. 3 April

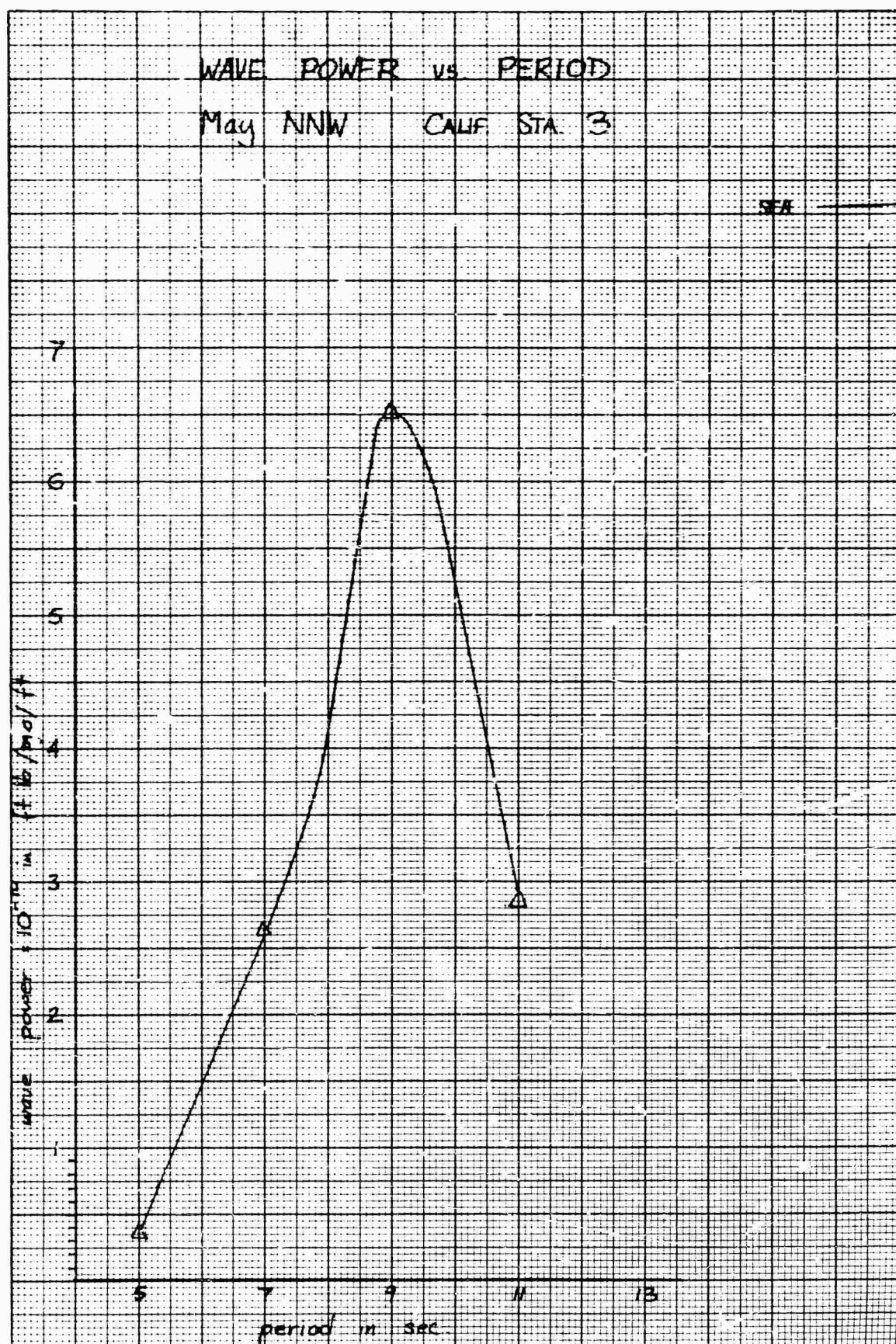
Directions: SSW, S, + SSE



STATION 3 - MAY

K&E 10 X 15 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



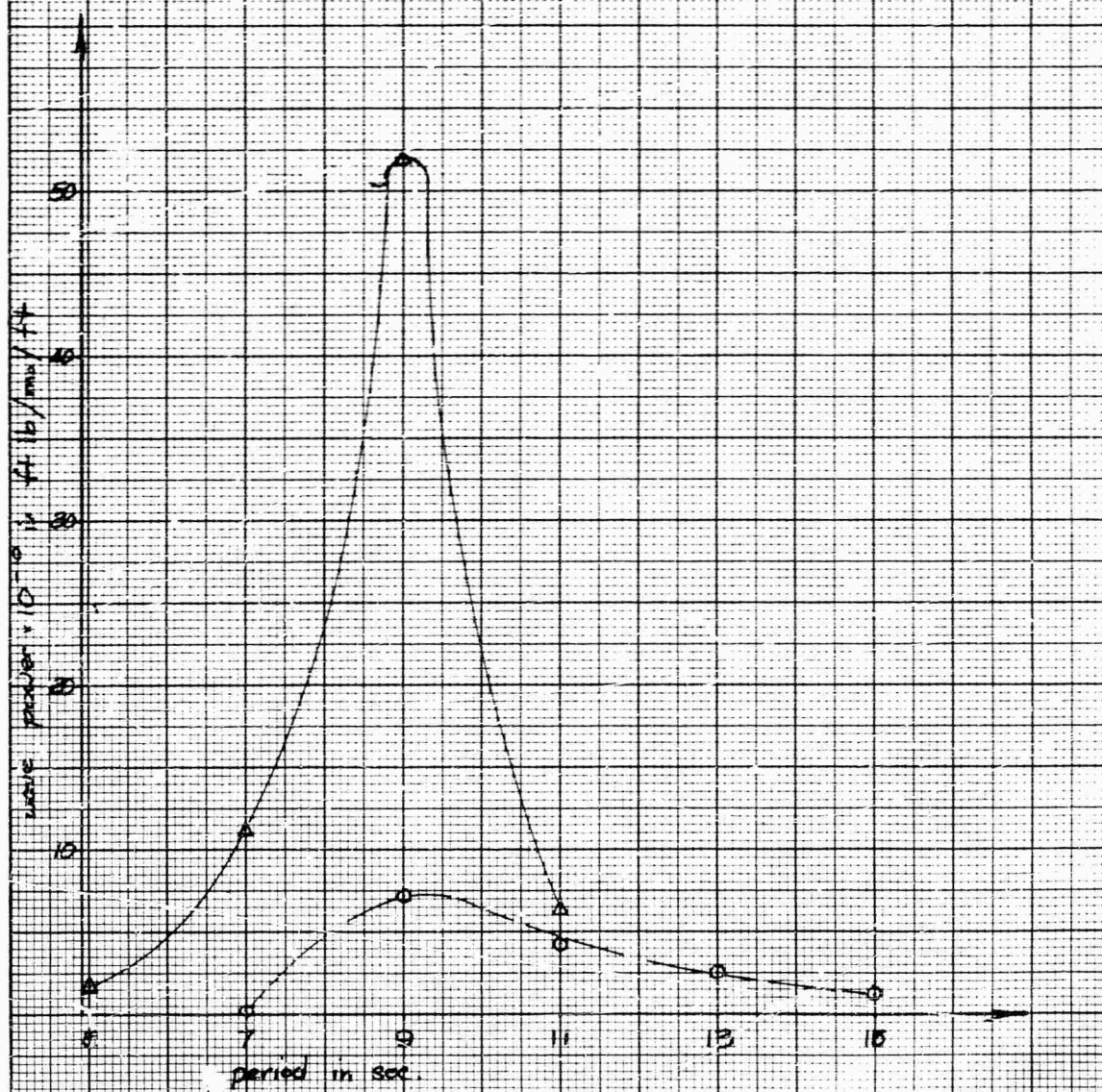


WAVE POWER VS. PERIOD

CALIF. STA. 3

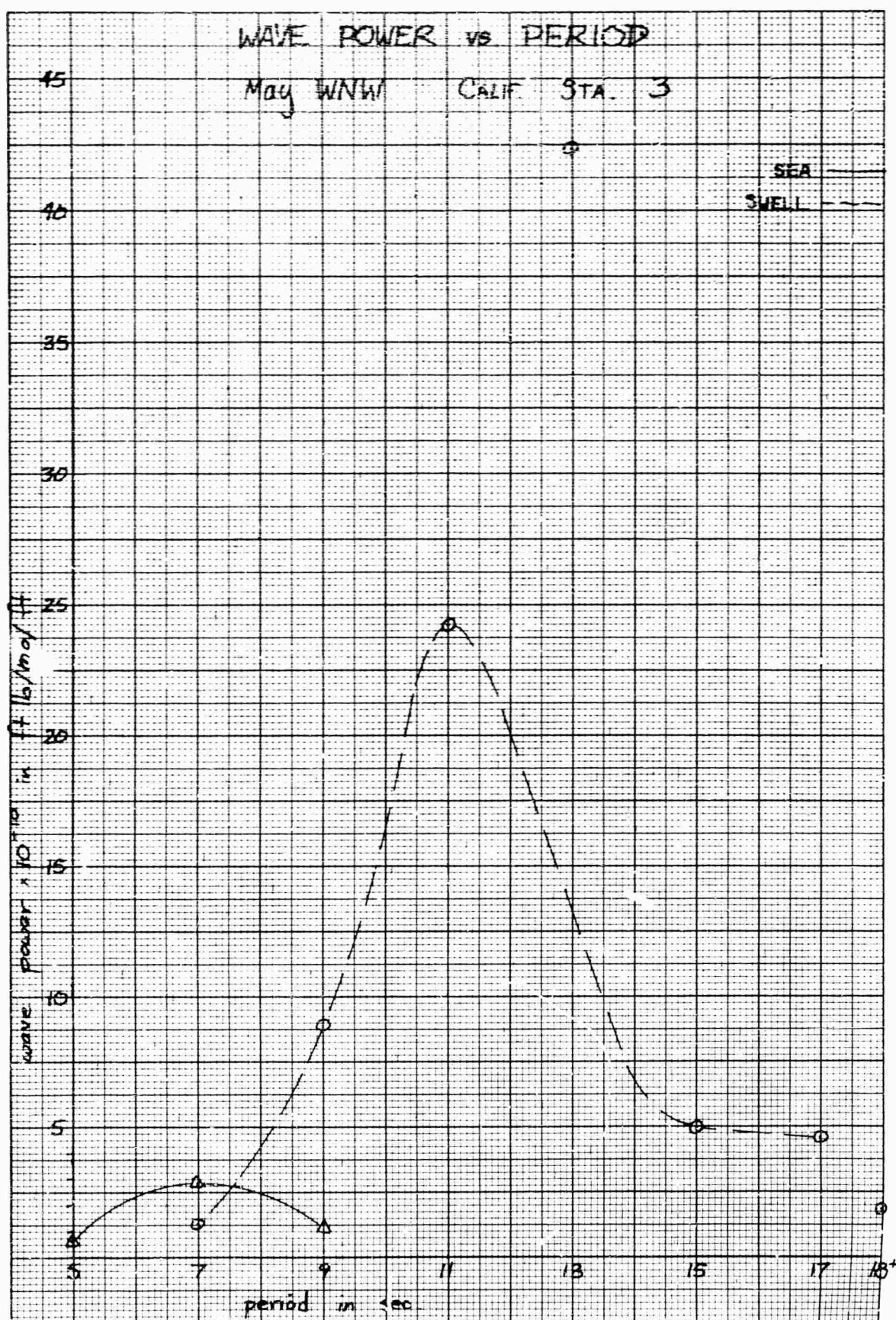
MAY

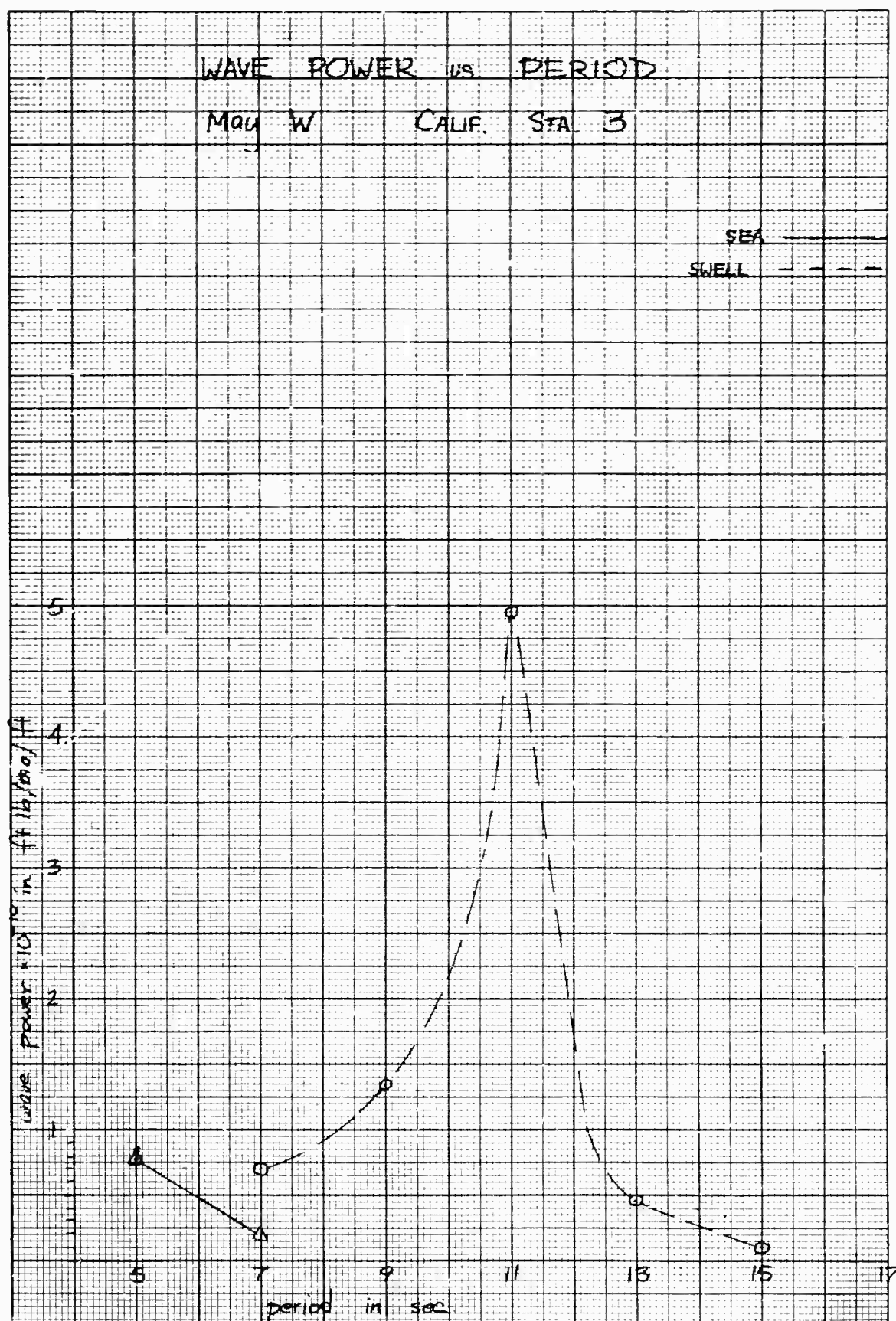
NW

SEA _____
SWELL _____

K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

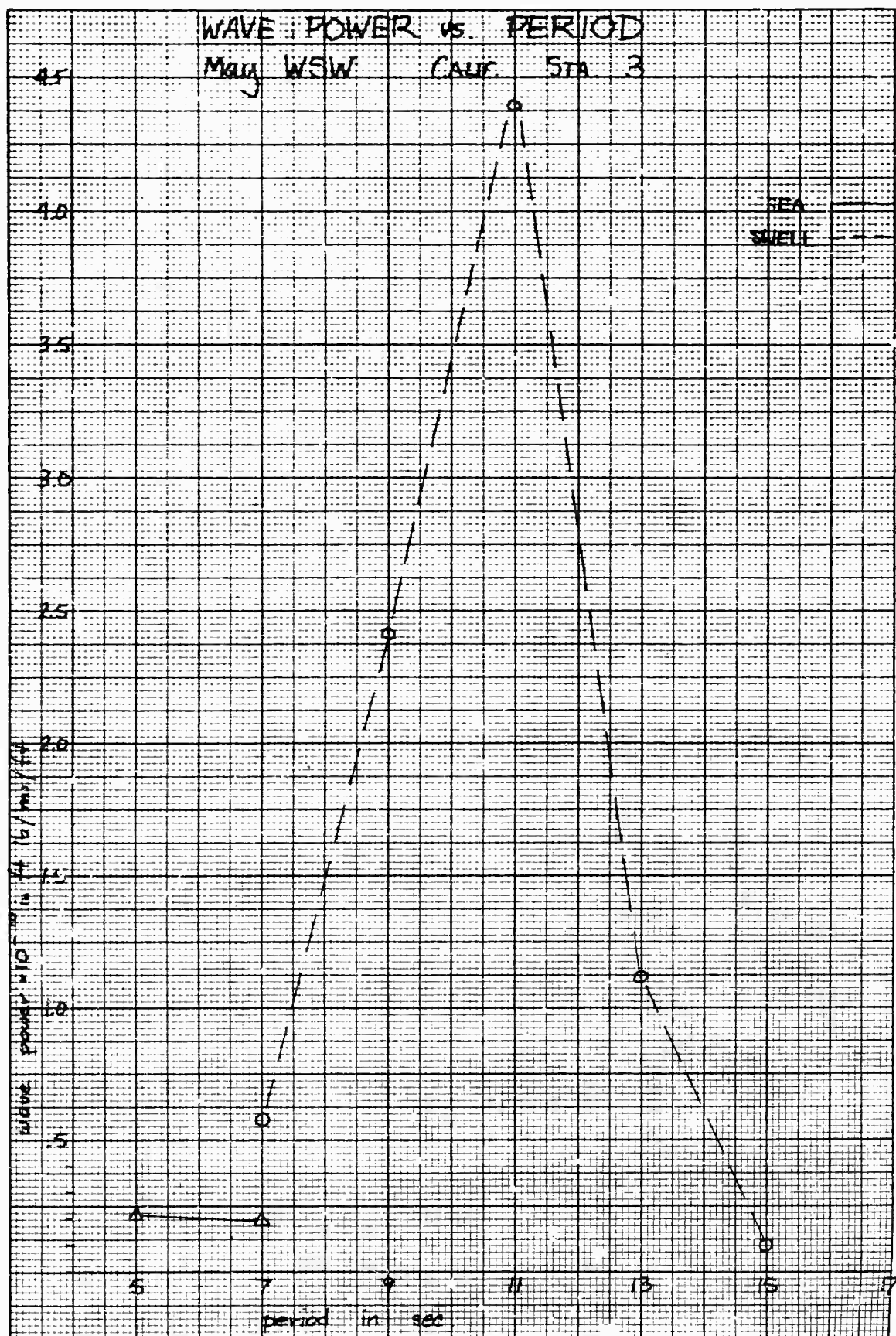
K&E 10x10 to 1/2 inch 45 1323
7x10 INCH
KEUFEL & ESSER CO.



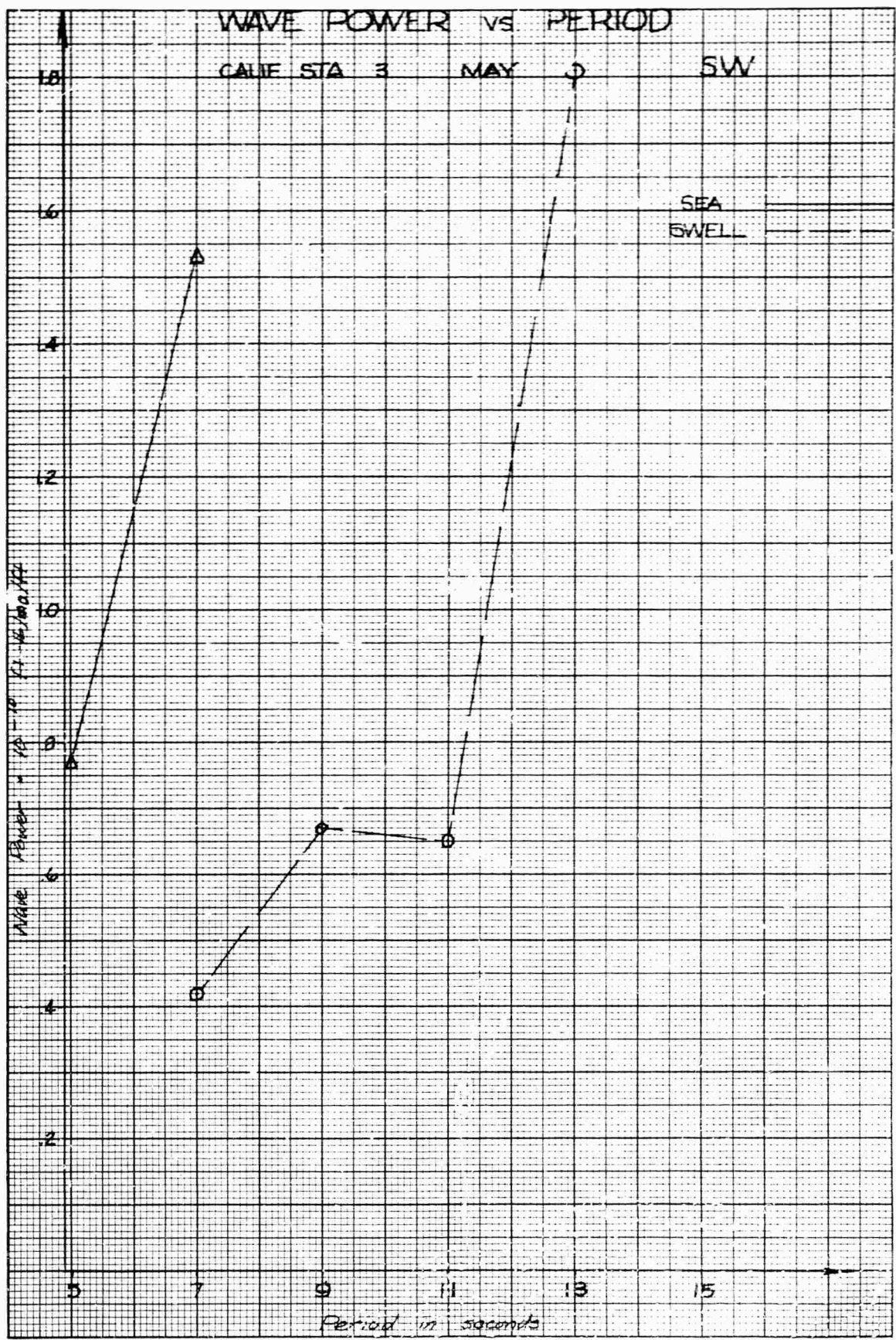


K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUPFEL & EBER CO.

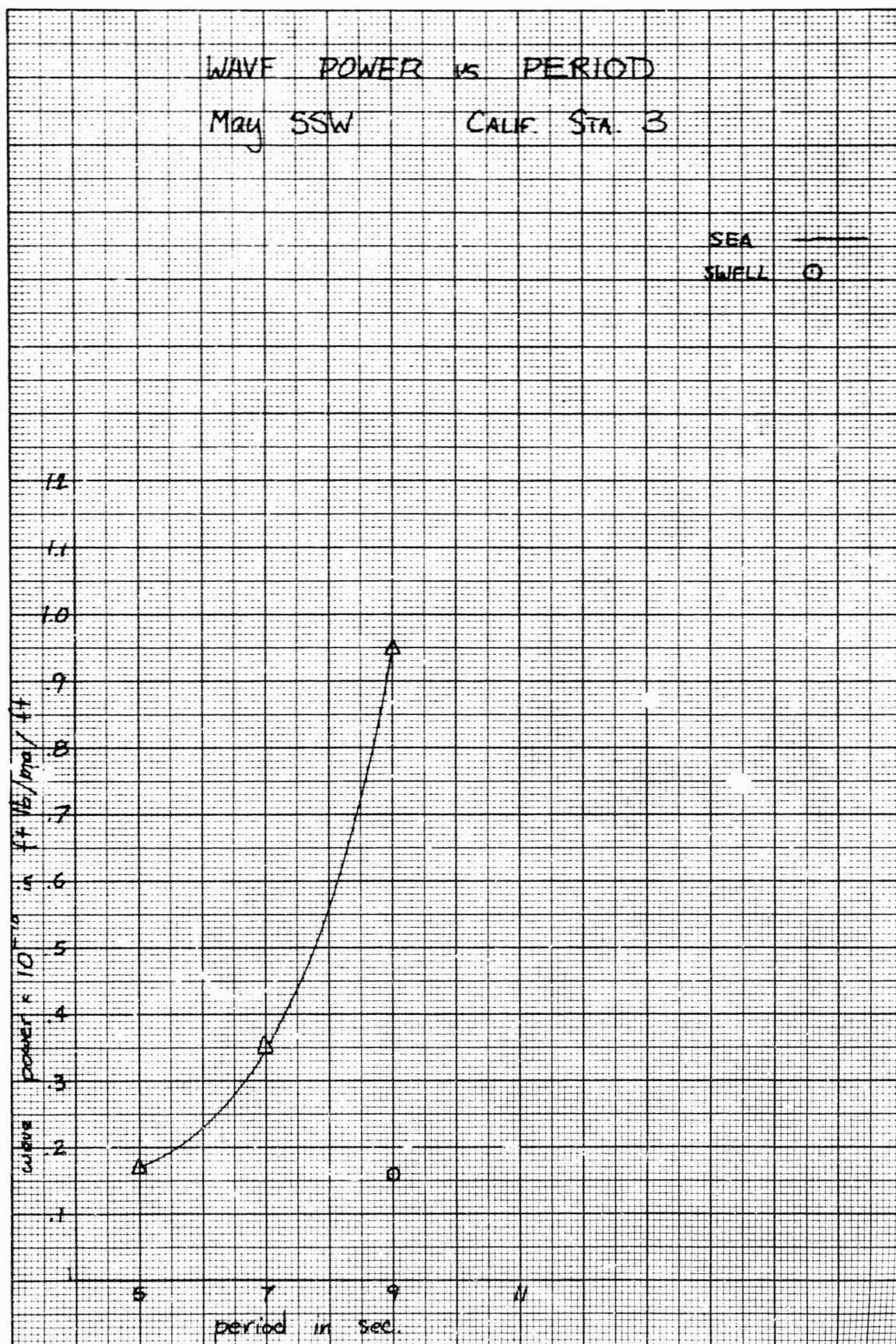
K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCH 6
KEUFFEL & ESSER CO.



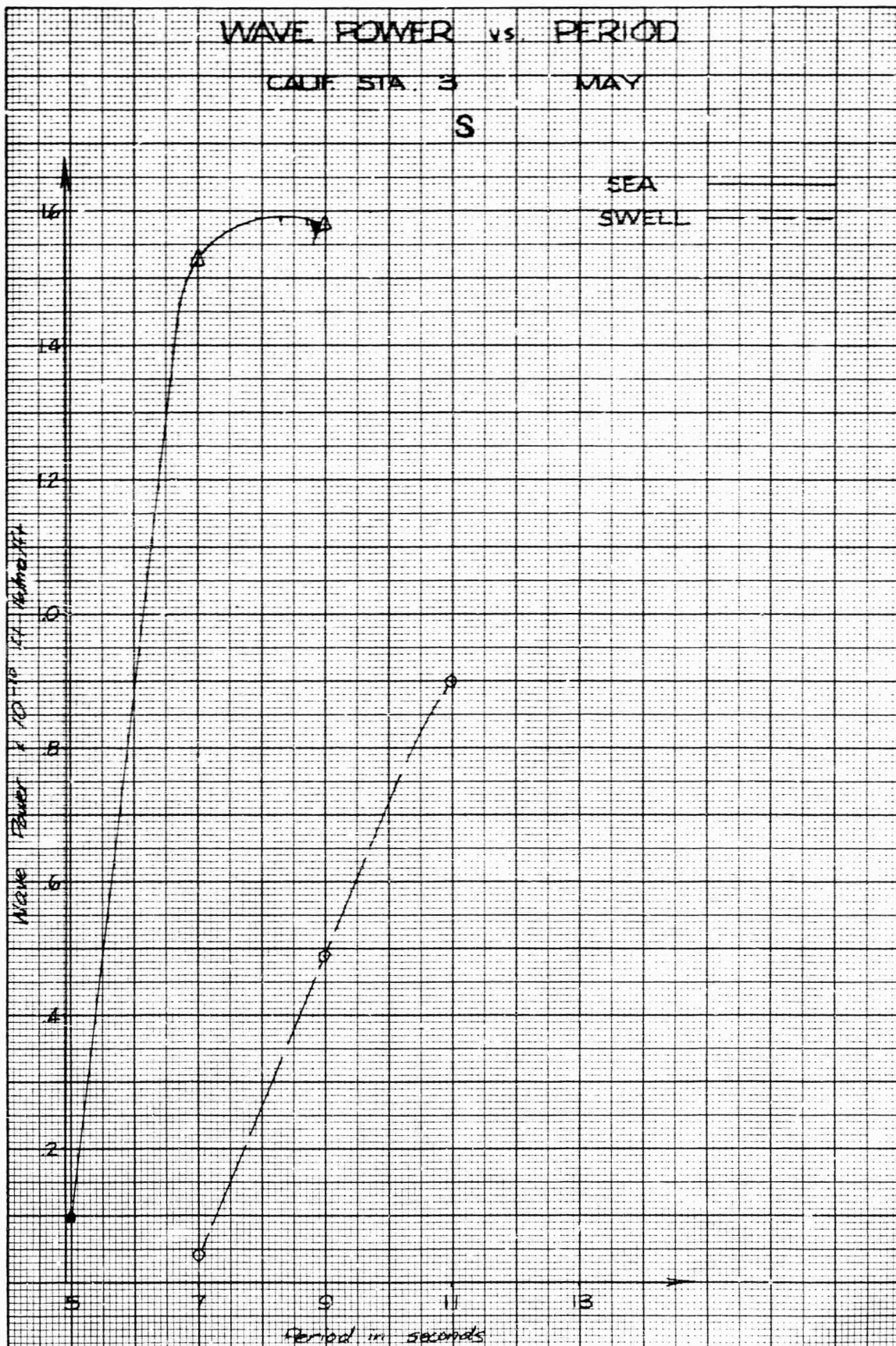
K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



K-E 10 X 10 1/2 INCH 46 1323
7 X 10 INCH
MADE IN U.S.A.
KEUFFEL & ESSER CO.



K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

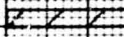
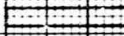


STATION 3 - JUNE

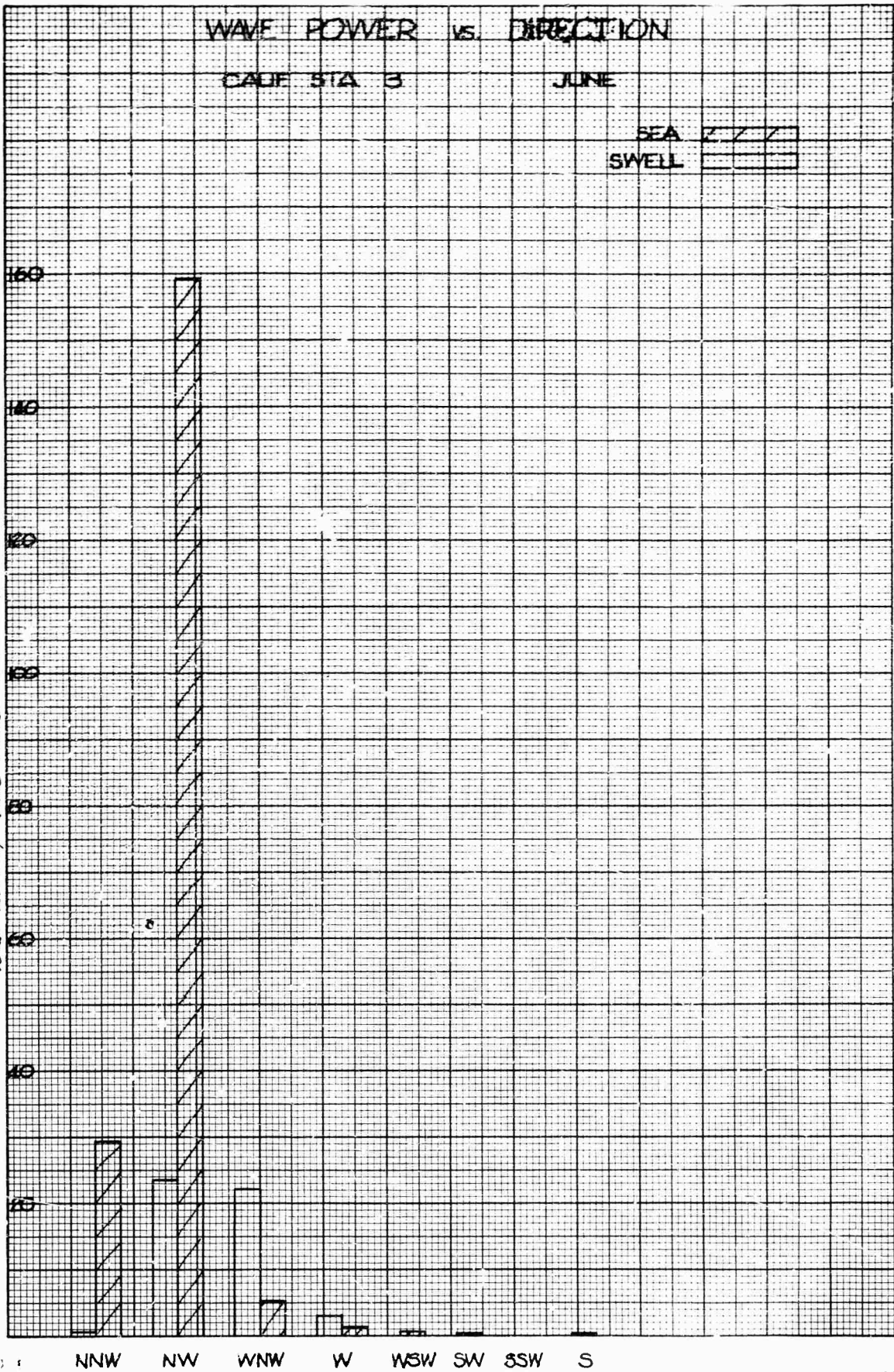
WAVE POWER vs. DIRECTION

CAUF STA 3

JUNE

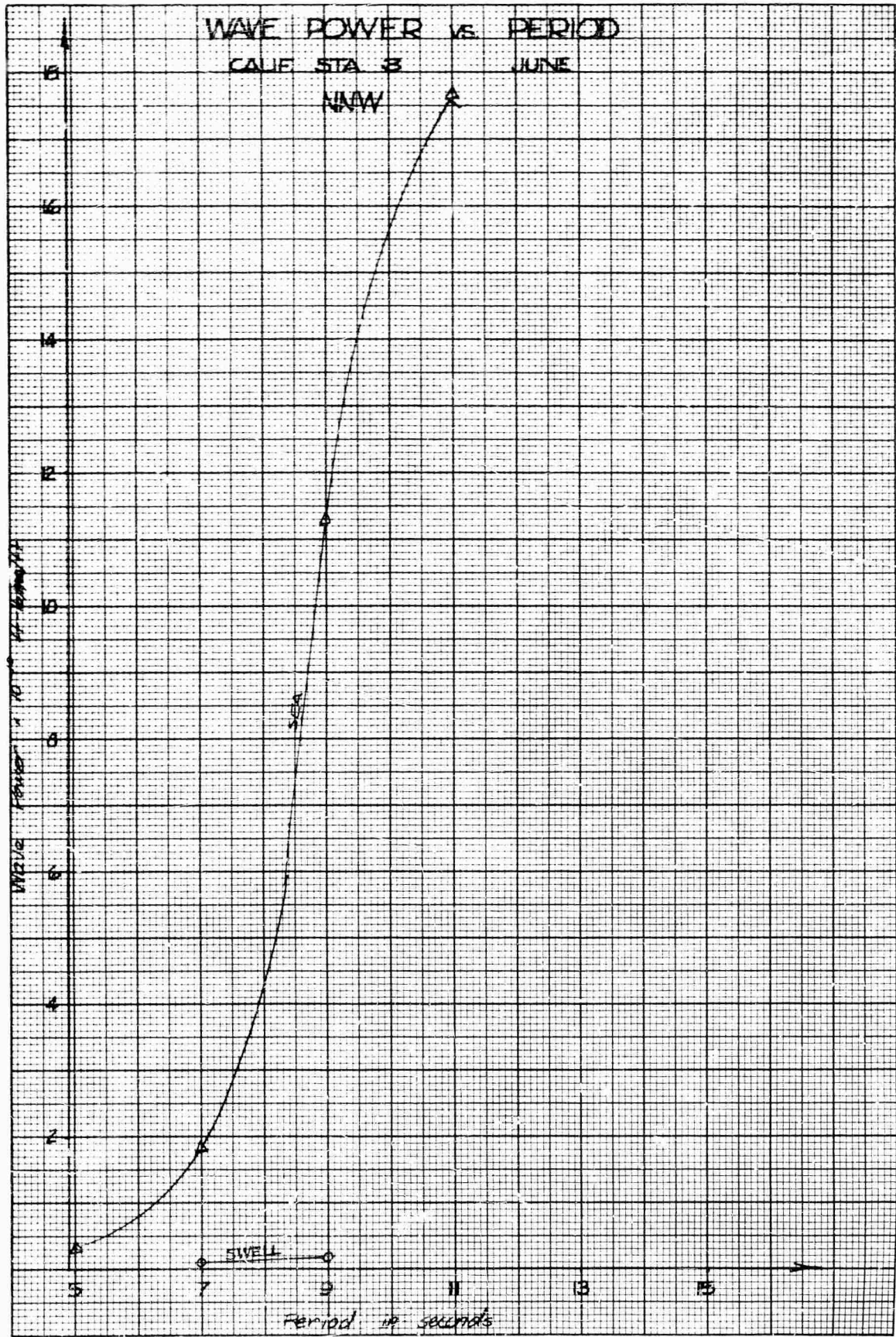
SEA 
SWELL 

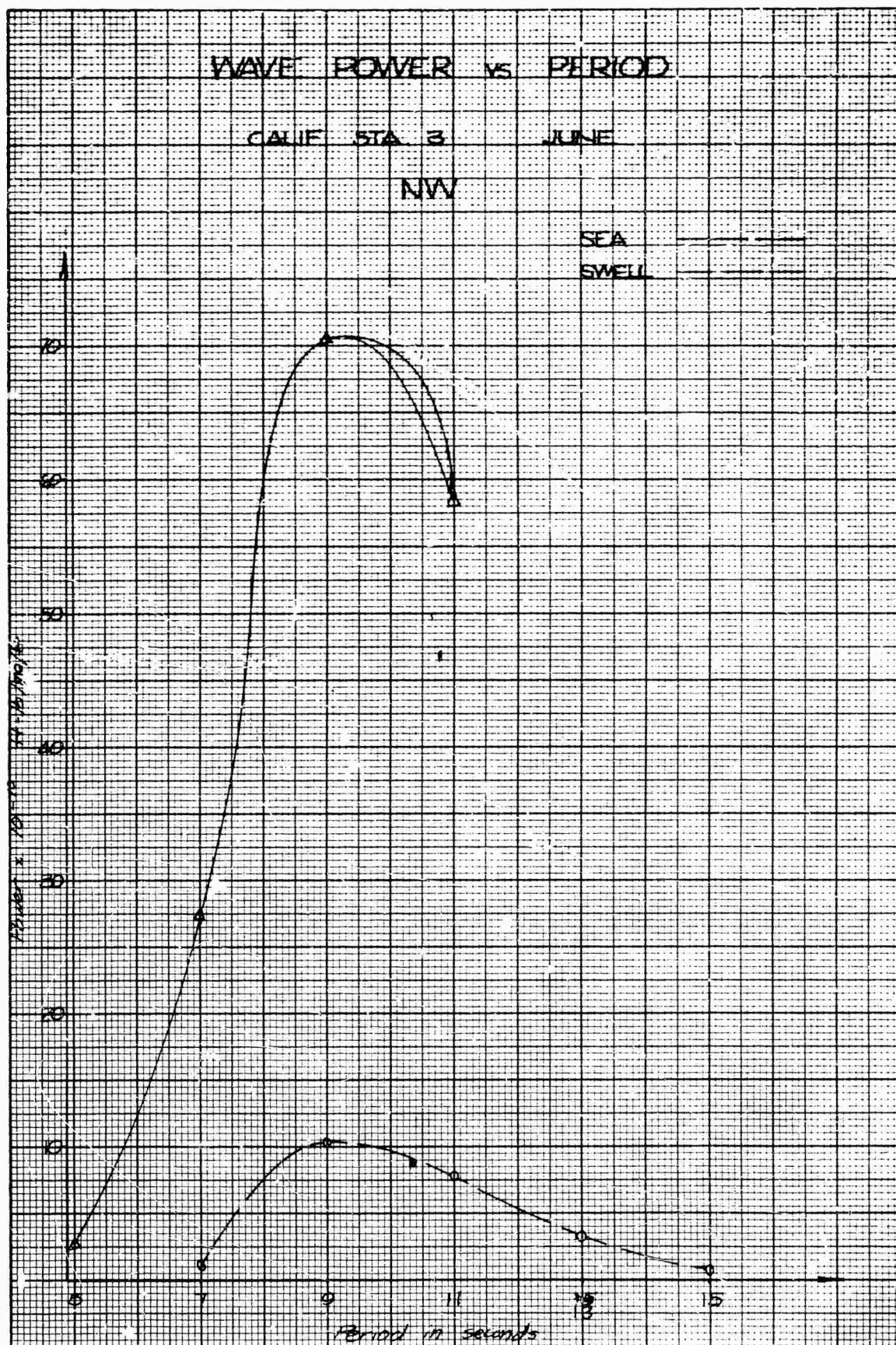
Total Monthly Wave Power $\times 10^{-10}$, ft-lb/mon/ft



K-E 10 X 10 TO 1 1/2 INCH 46 1323
7 X 10 INCH
MADE IN U.S.A.
KEUFFEL & ESSER CO.

K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES PARTIAL U.S.A.
KEUFFEL & ESSER CO.





K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

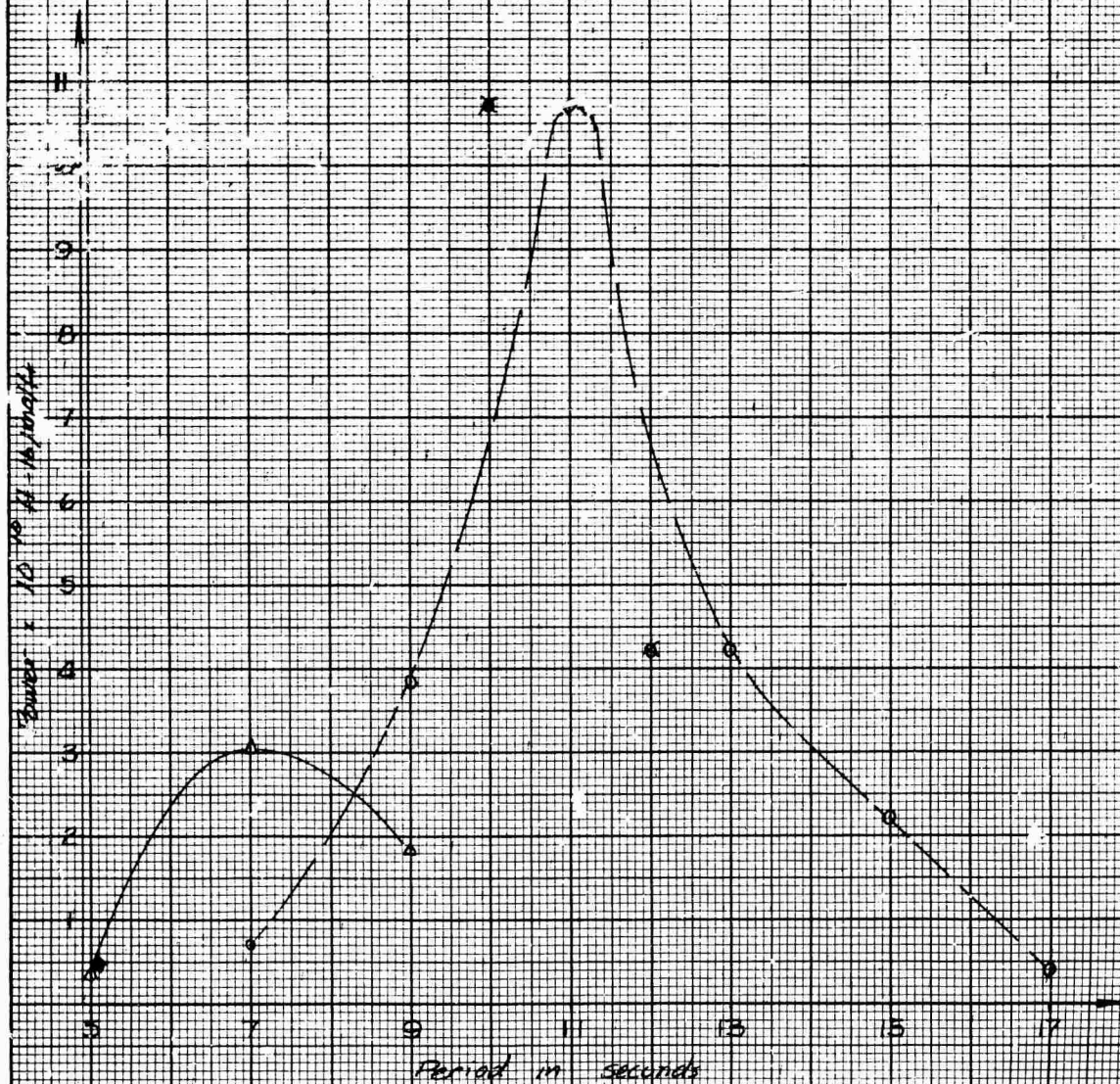
WAVE POWER vs PERIOD

CALIF STA 3 JUNE

WNW

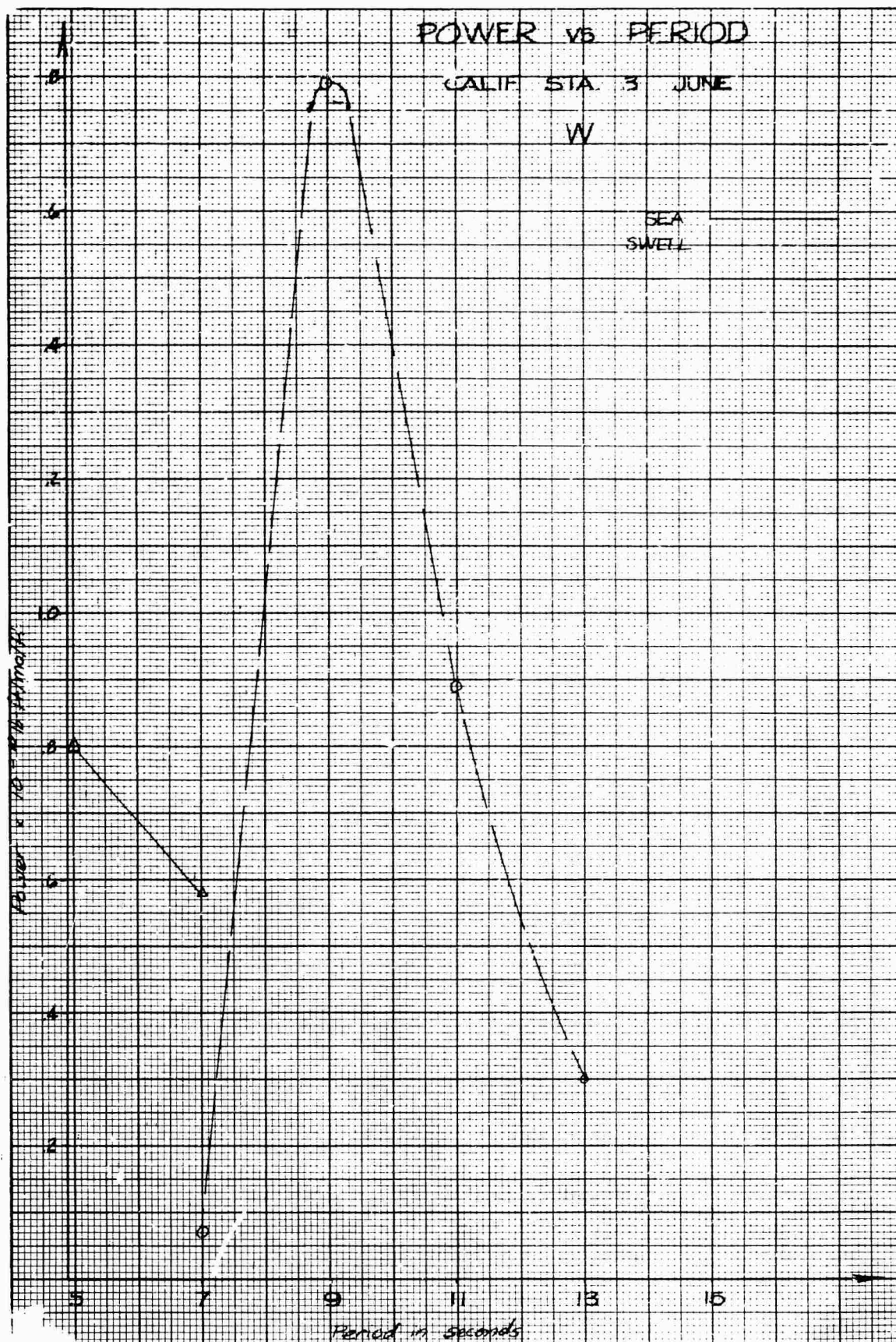
SEA

SWELL



K-E 10 X 10 TO 1/2 INCH 46 1323
 7 X 10 INCHES 46 1323
 KEUFFEL & ESSER CO.

K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

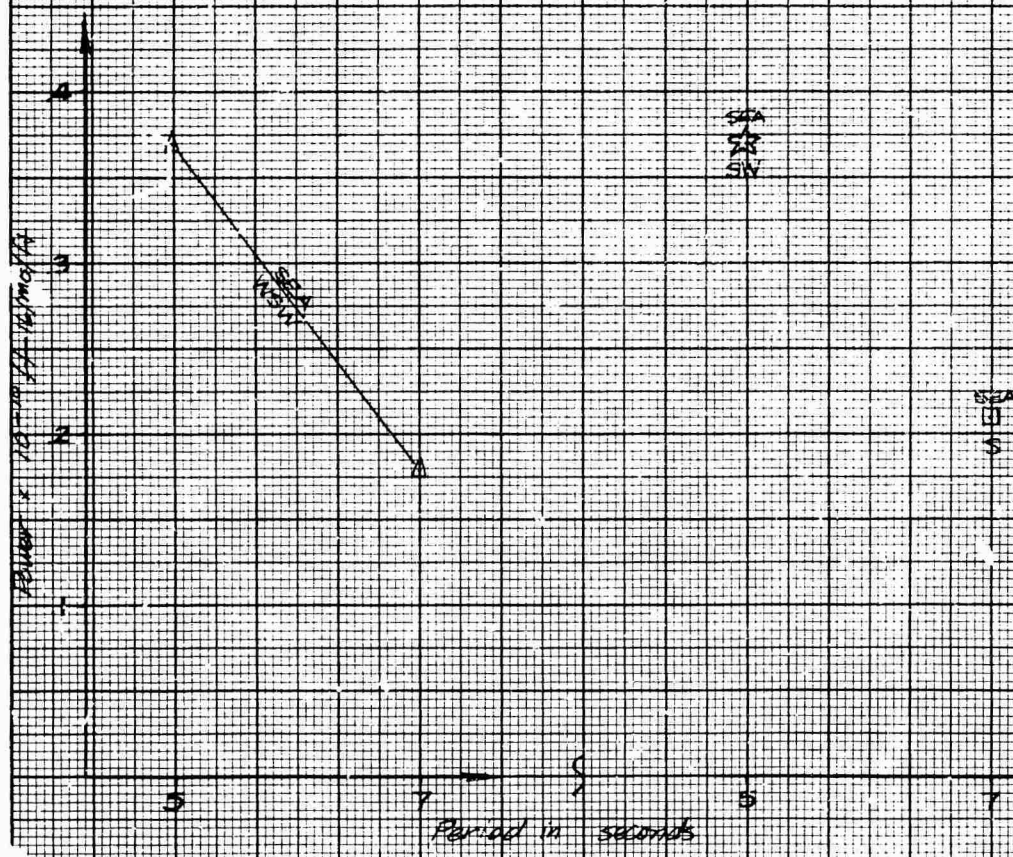


WAVE POWER vs PERIOD

CALIF STA 3 JUNE

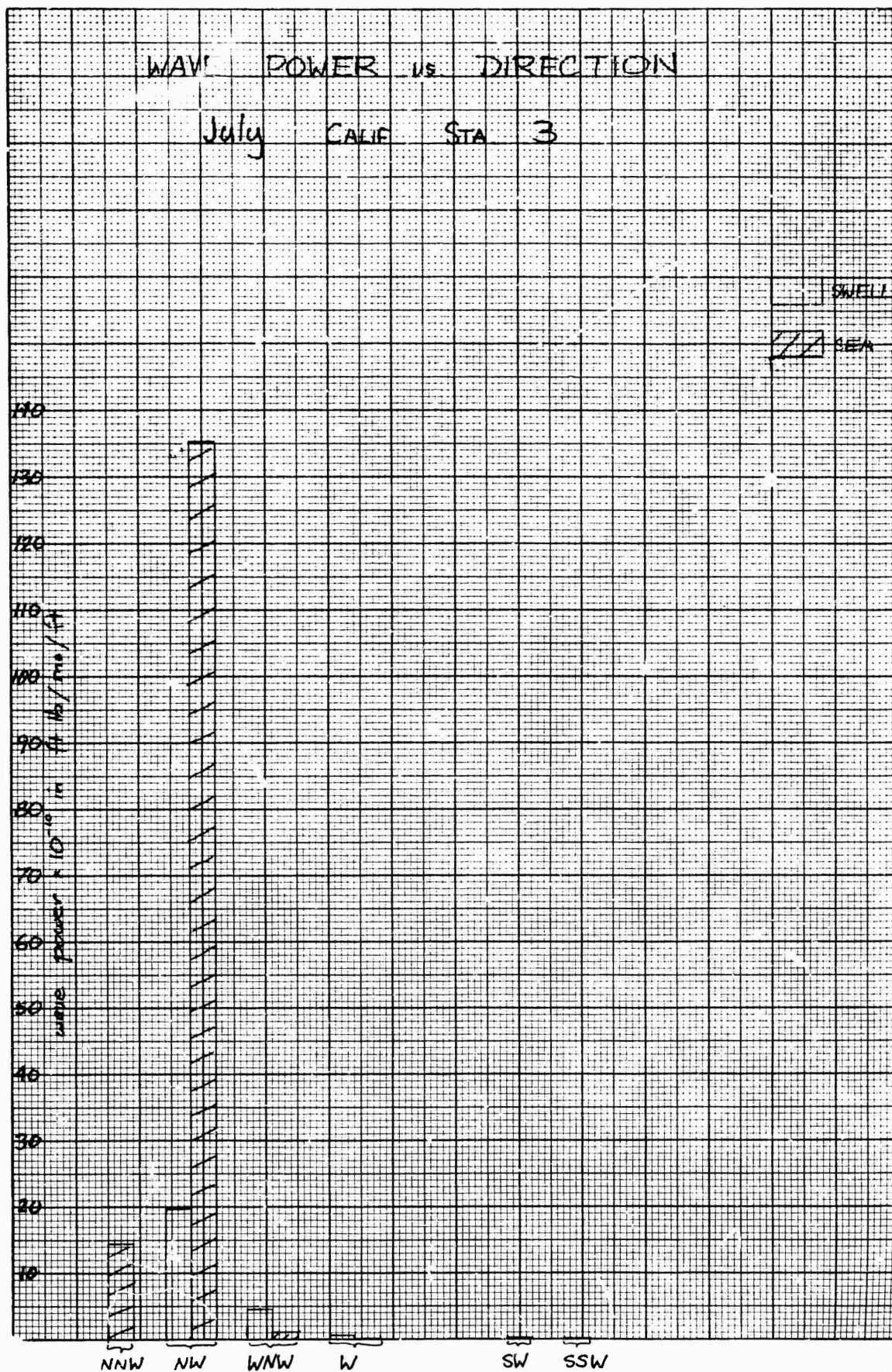
WSW, SW, S

K-E 10 X 10 TO 1/2 INCH 46 1323
 7 X 10 INCHES MADE IN U.S.A.
 KEUFFEL & ESSER CO.

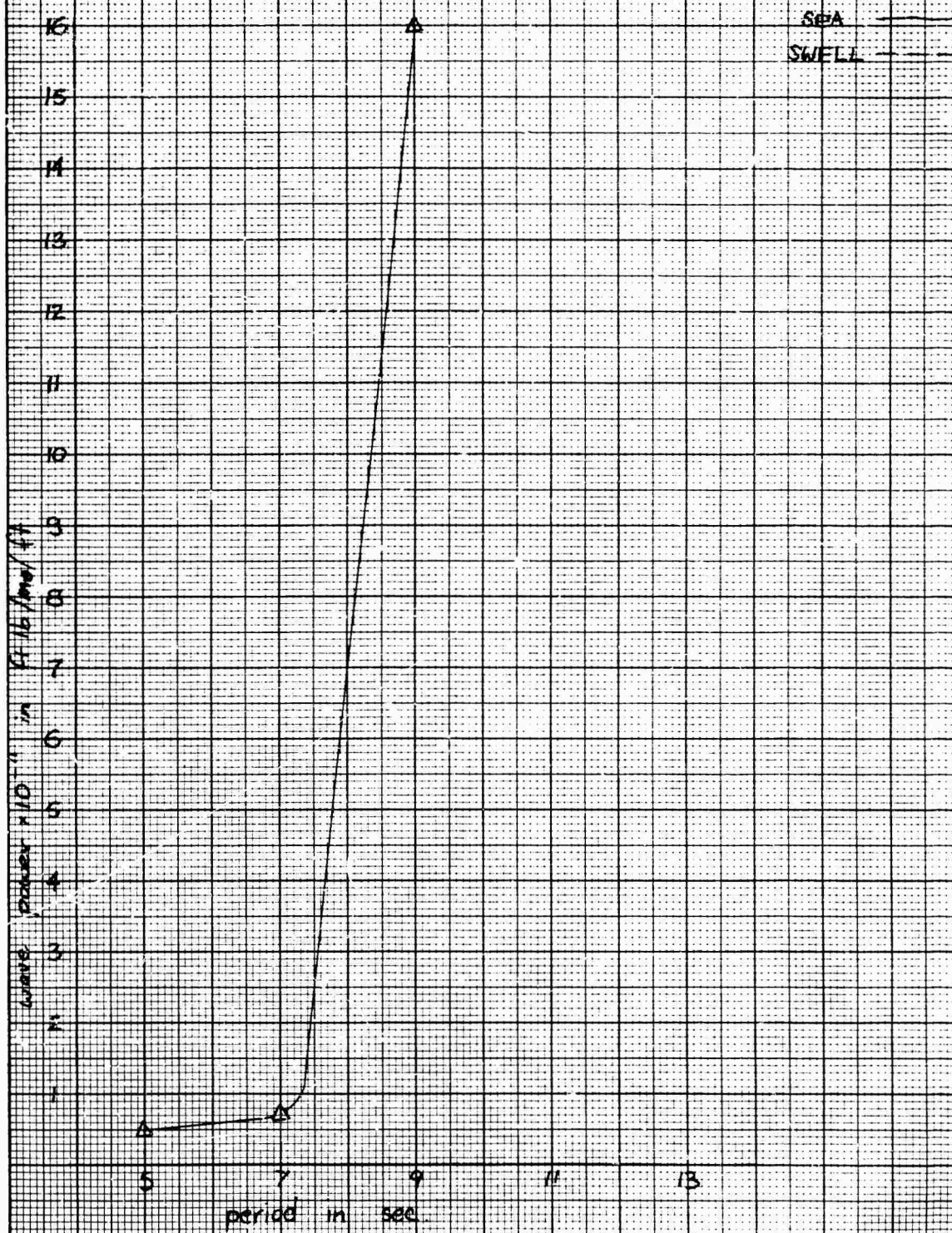


STATION 3 - JULY

K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

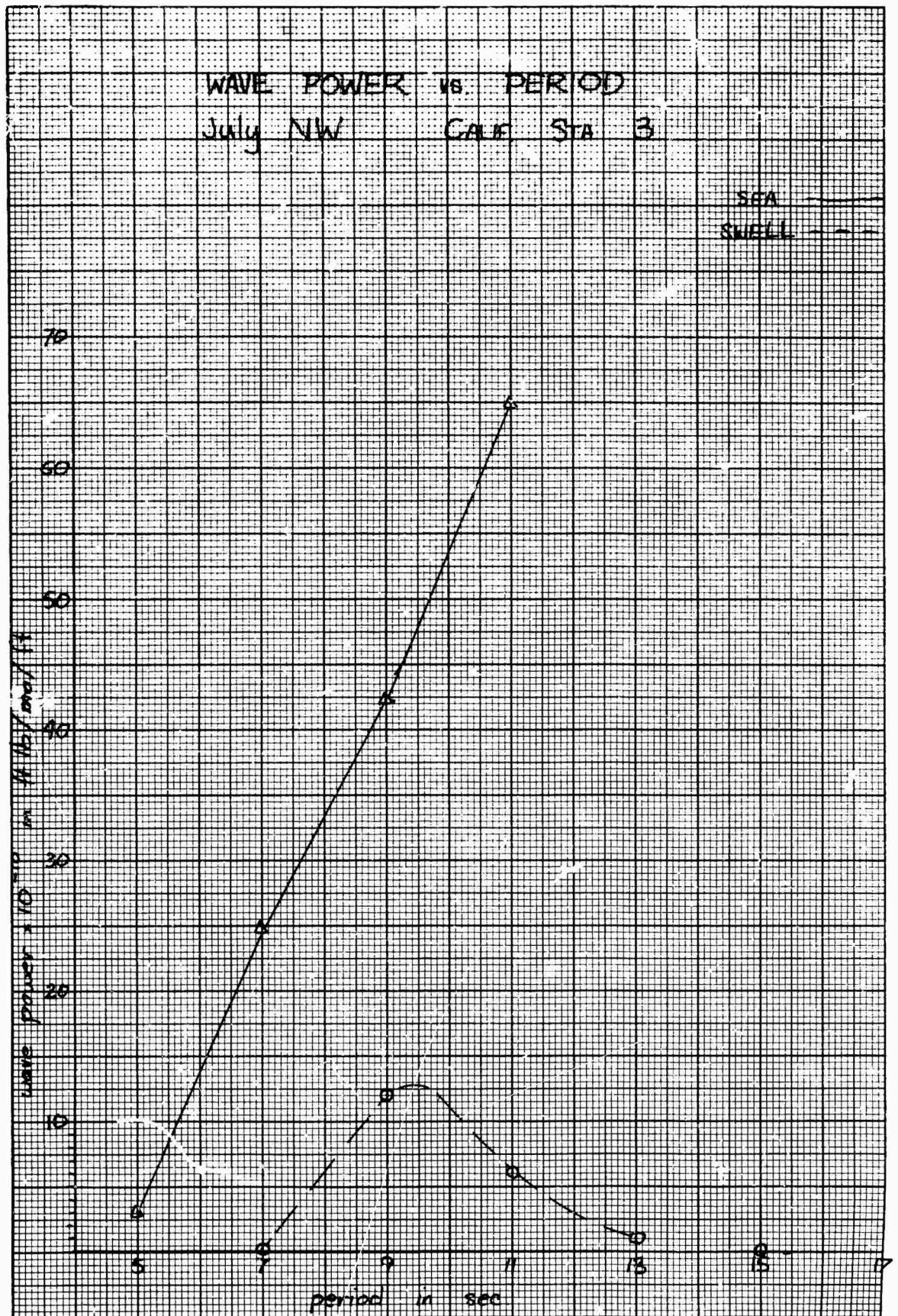


WAVE POWER VS. PERIOD July NNW CALIF. STA. 3

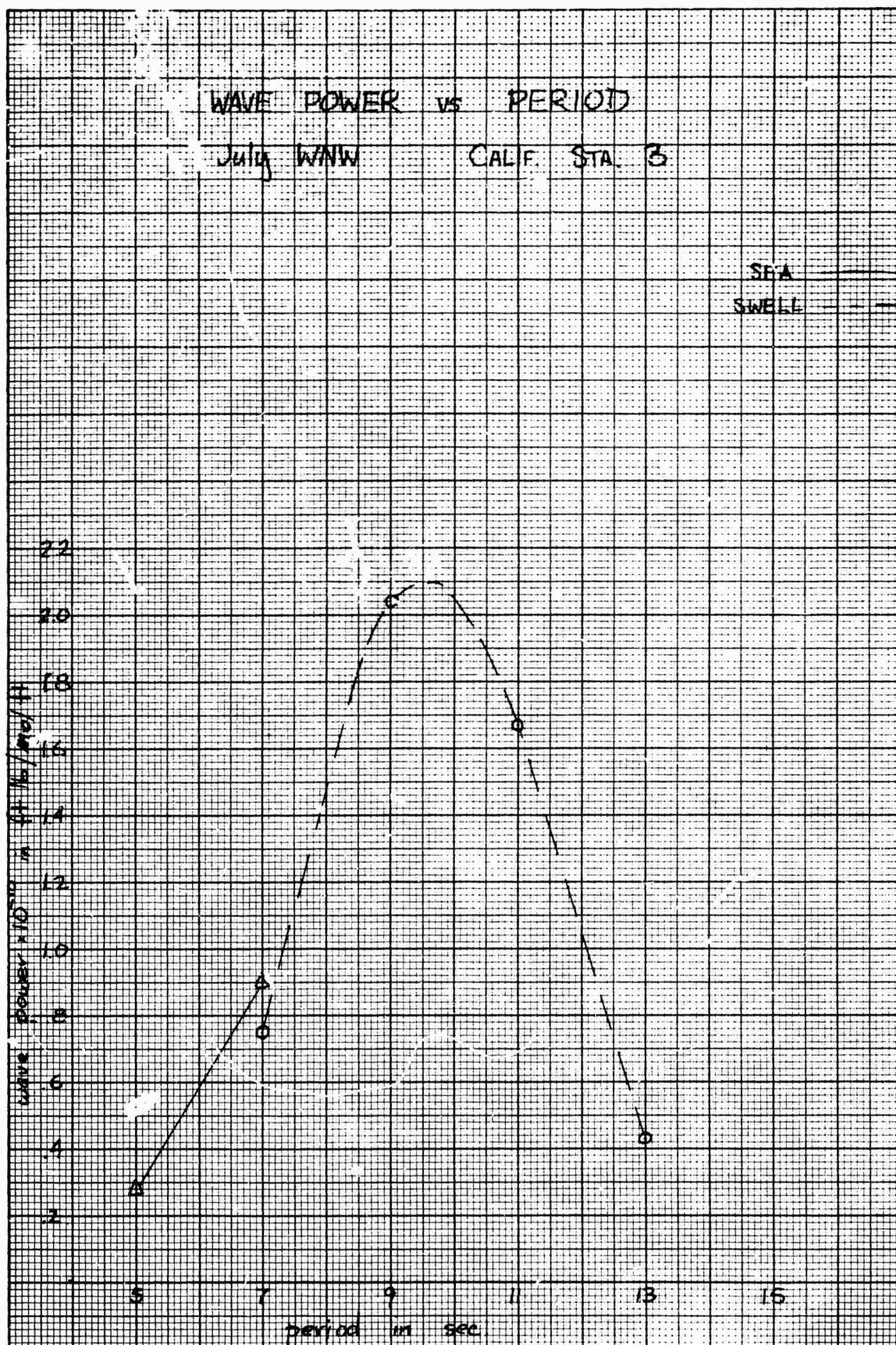


K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

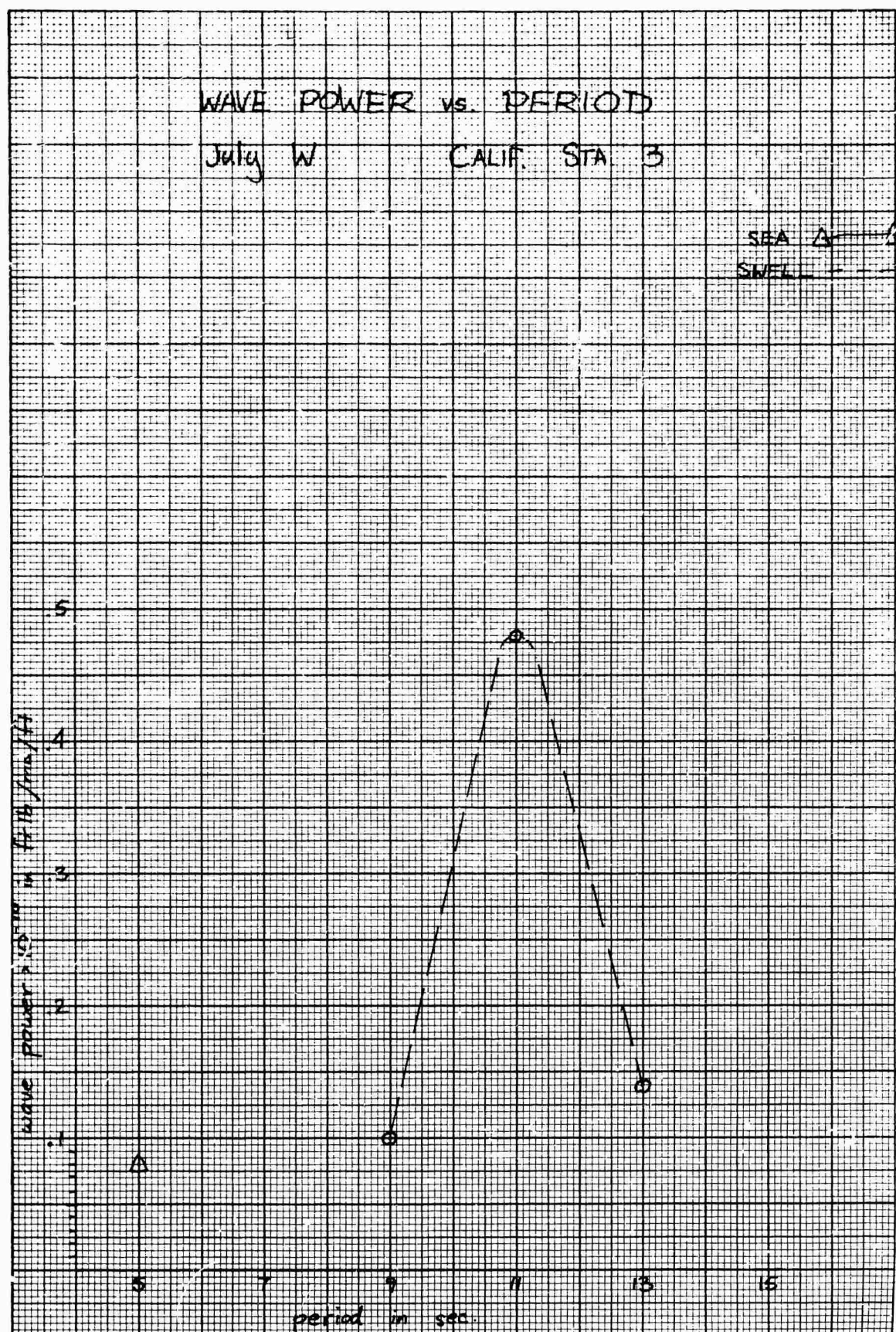
K-E 10 X 10 TO 1/2 INCH 48 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.



K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



K&E
10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
KEUFFEL & ESSER CO.



WAVE POWER vs PERIOD
JULY SW, SSW CALIF STA 3

SEA Δ

wave power $\times 10^{-10}$ in ft^2/sec^3

Δ SW

Δ SSW

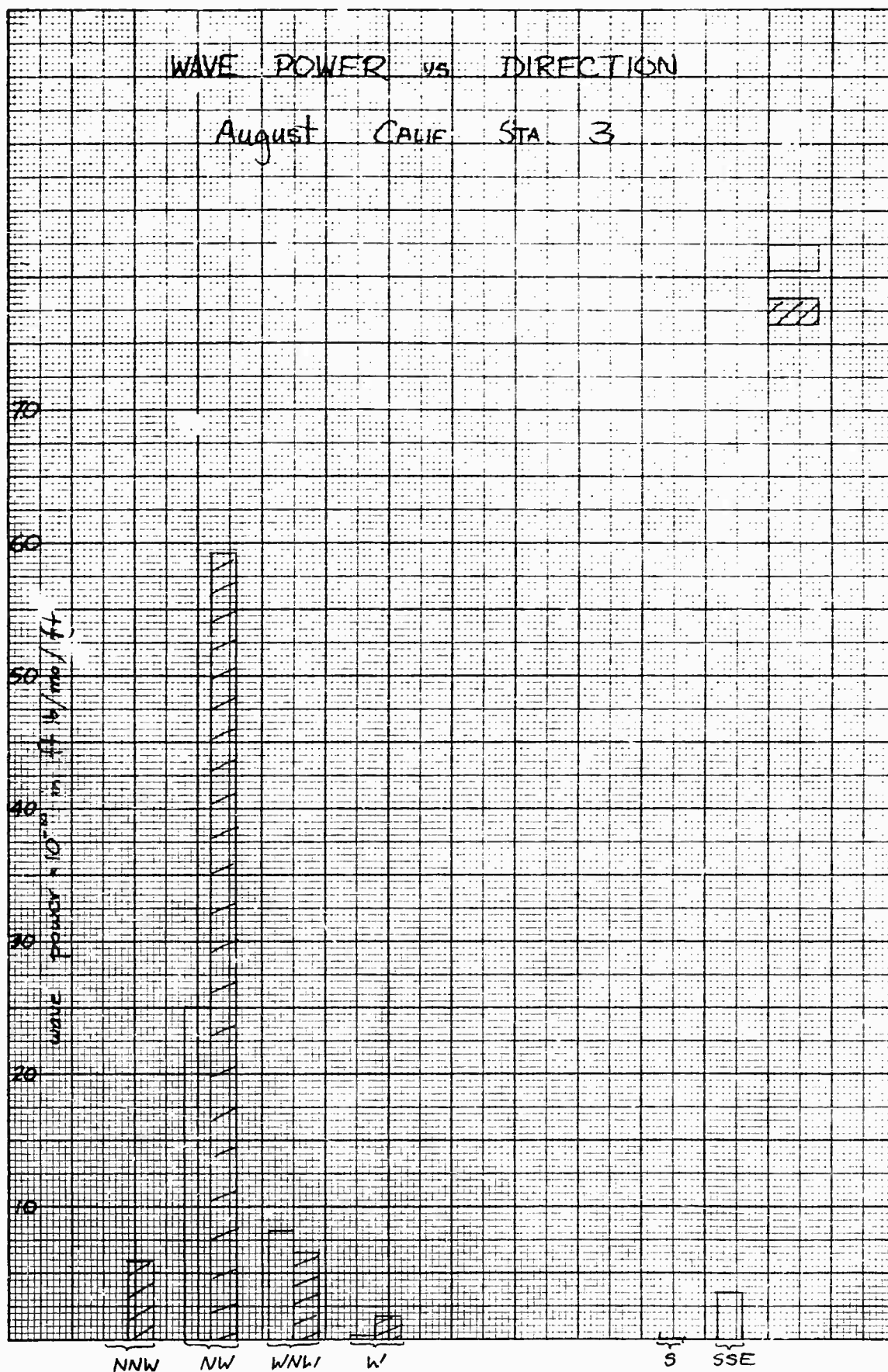
5 7 9
period in sec.

K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

STATION 3 - AUGUST

WAVE POWER vs DIRECTION

August CALIF STA 3

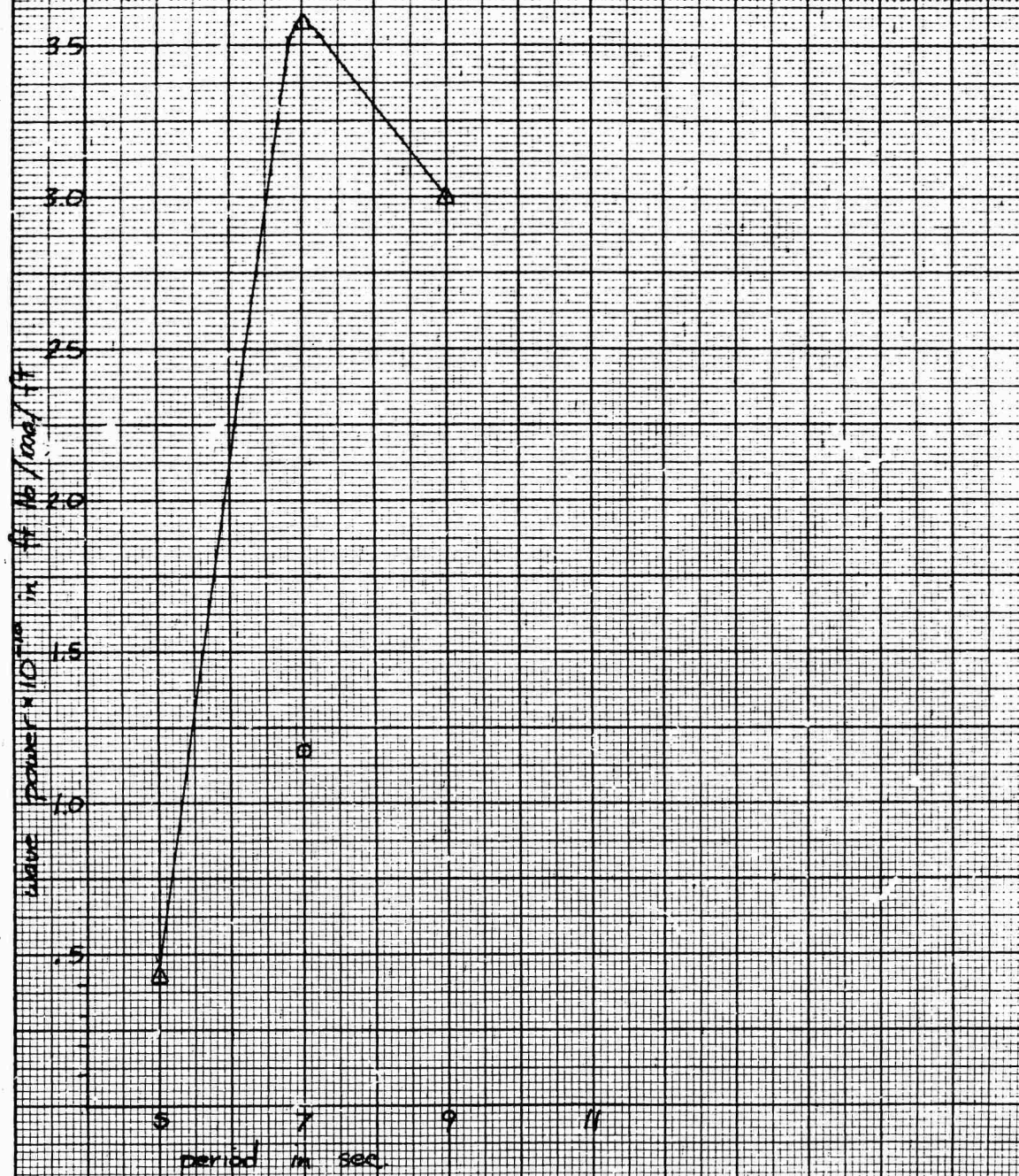


K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

WAVE POWER vs PERIOD

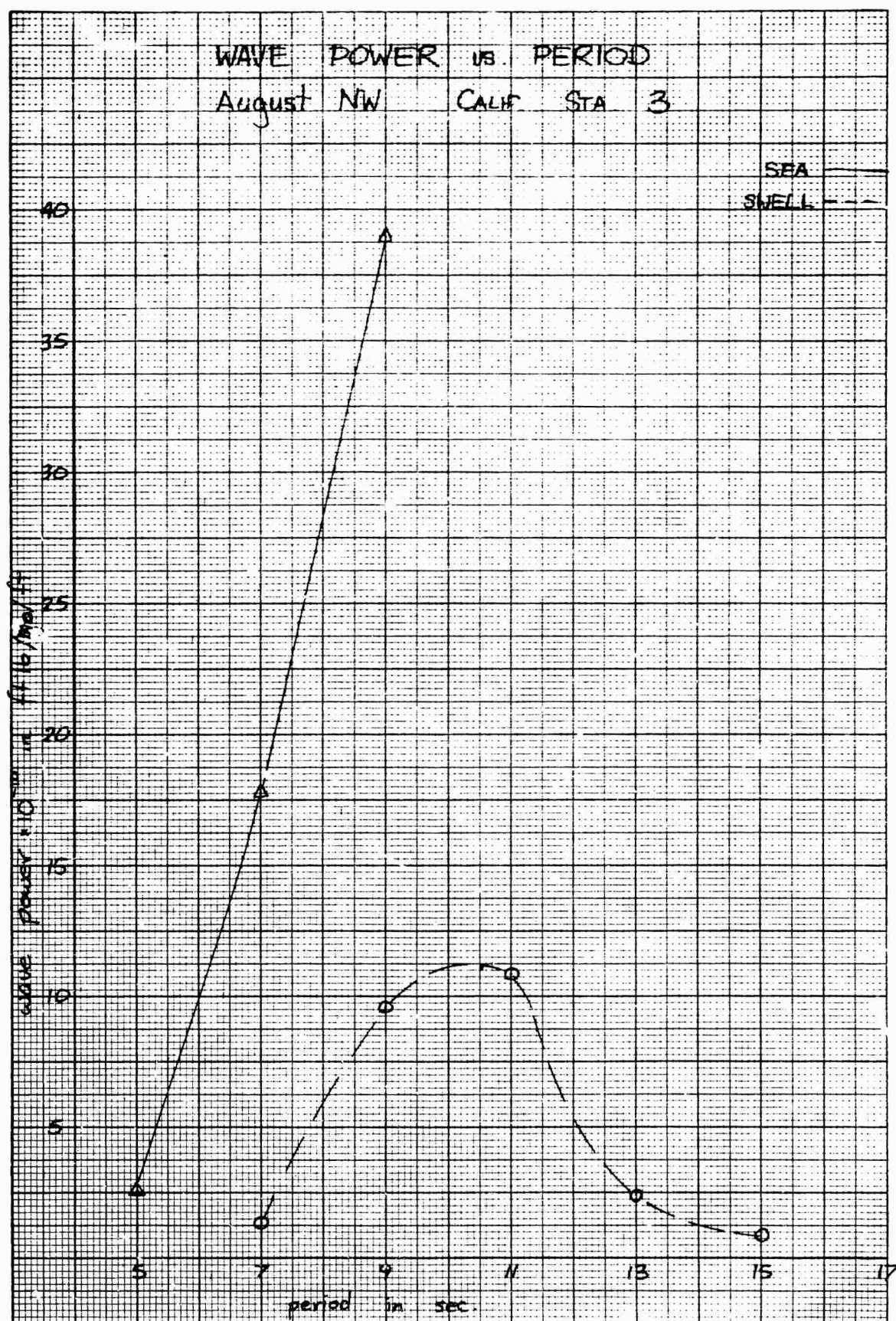
August NNW CALIF STA 3

SEA ———
SWELL —○—



K&E 10x10 to 1/2 INCH 46 1323
7x10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

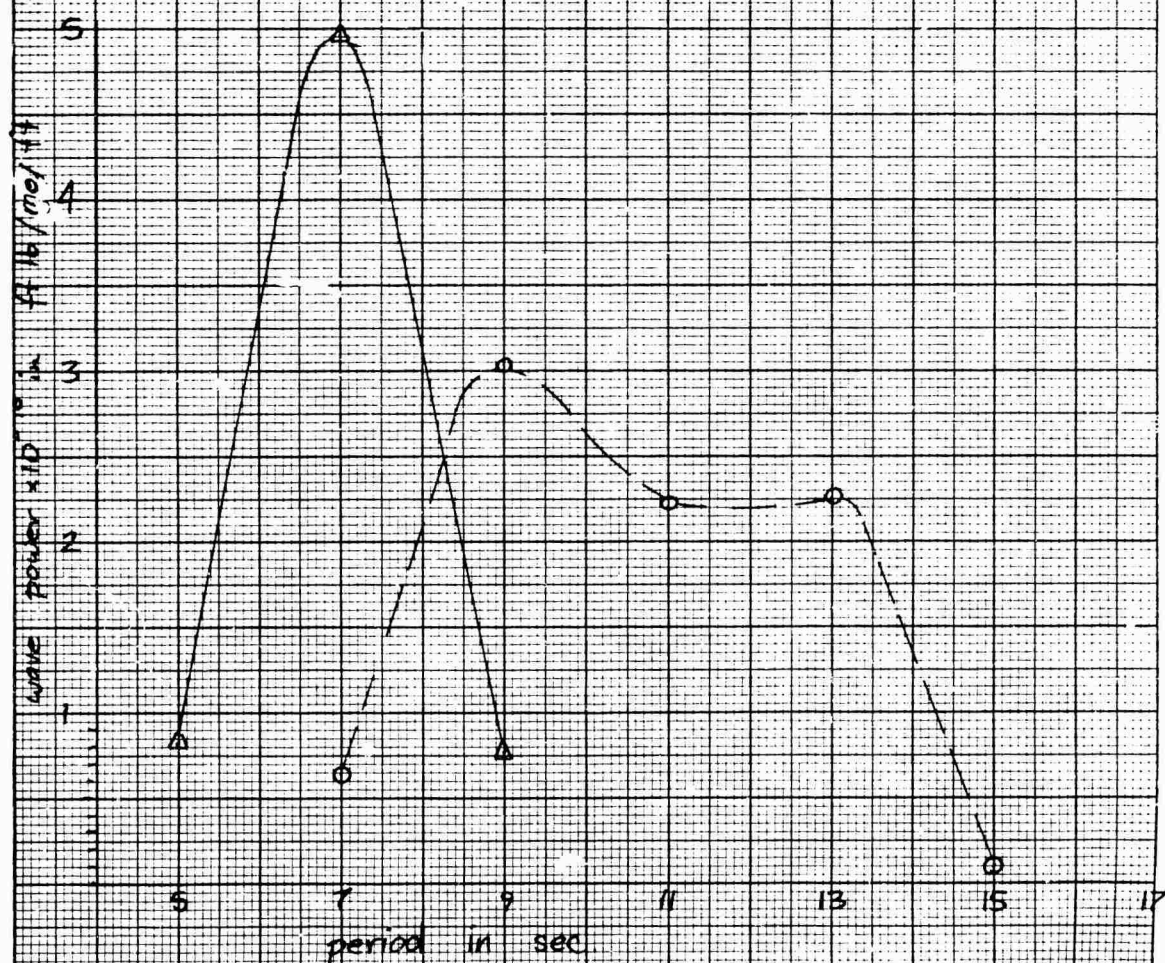
K-E 10 X 10 TO 1/2 INCH 461323
7 X 10 INCHES
MADE IN U.S.A.
KEUPFEL & ESSER CO.



WAVE POWER VS PERIOD

August WNW CALIF. STA. 3

SEA ———
SWELL - - -

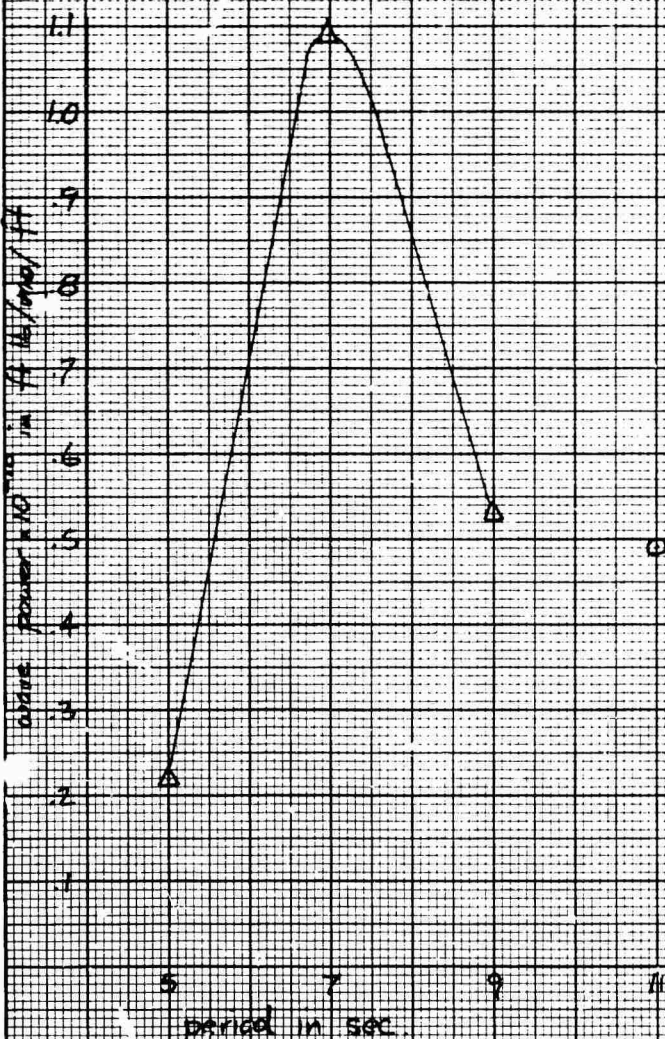


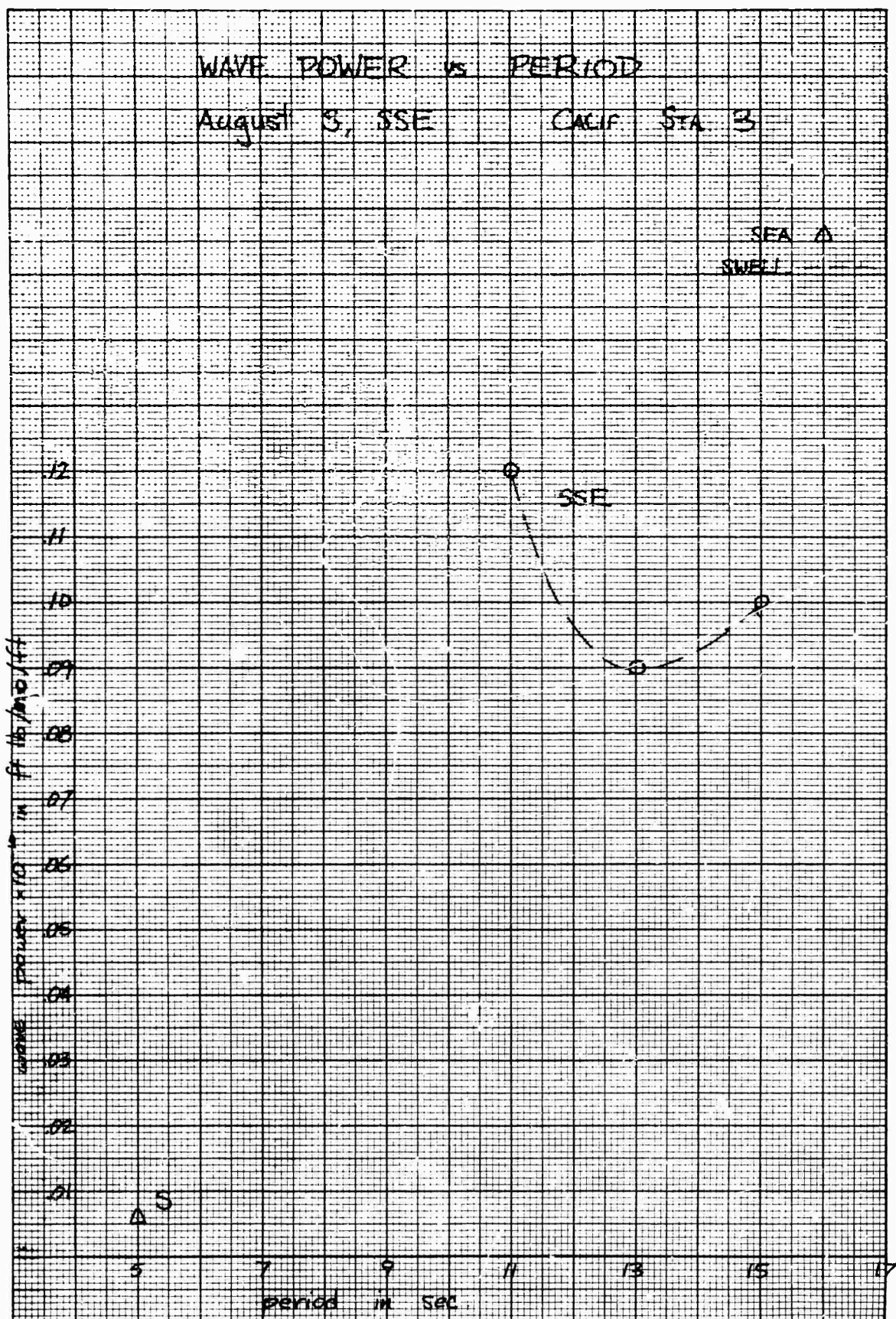
K&E 10 X 10 TO 1/2 INCH 461323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

WAVE POWER VS PERIOD

August W CALIF. STA. 3

SEA
SWELL



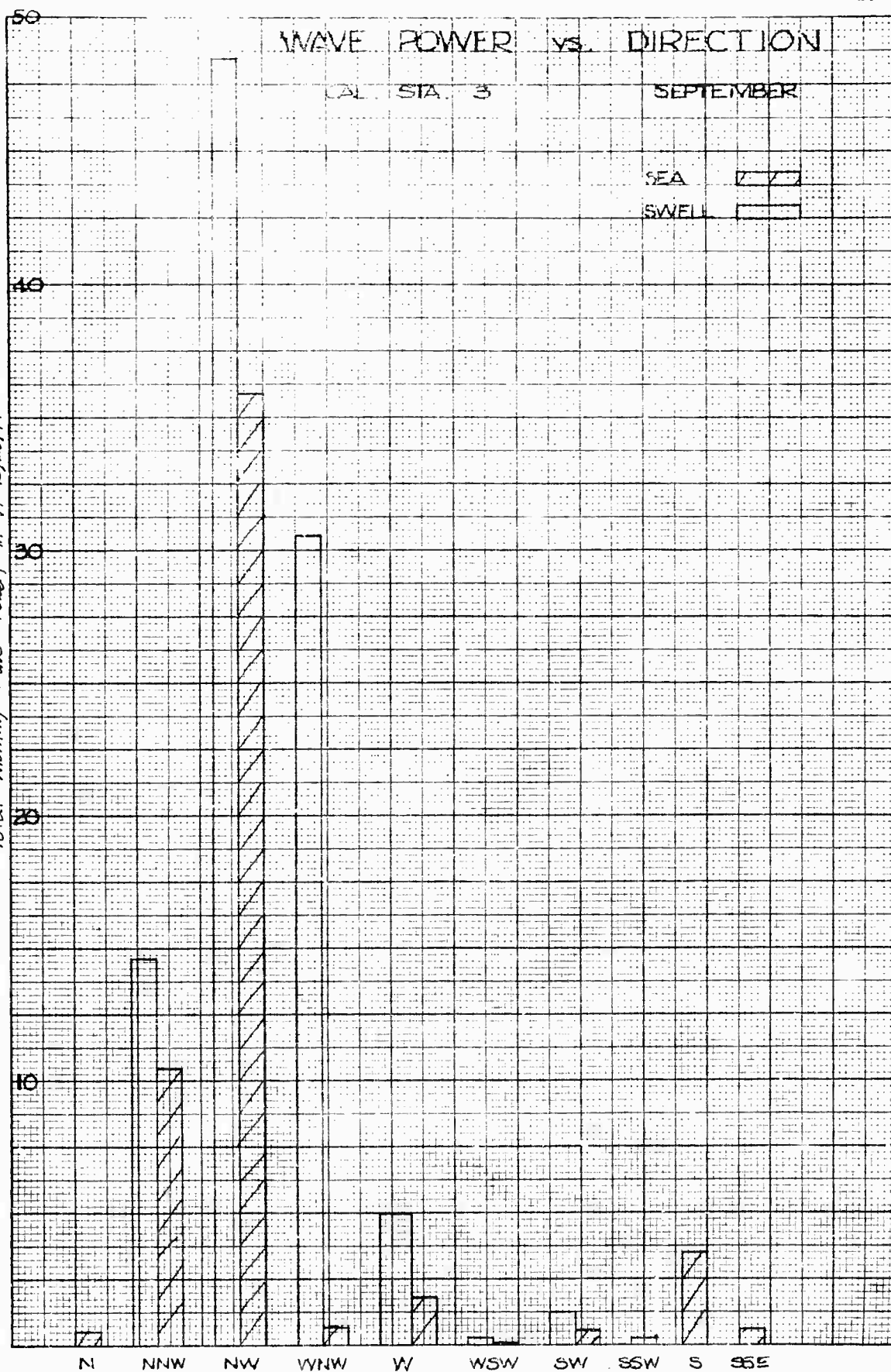


K.M.
10 X 10 TO 1/2 INCH 48 1923
7 X 10 INCHES
KEUPPEL & EISEN CO.
MADE IN U.S.A.

STATION 3 - SEPTEMBER

K-Σ 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCH MADE IN U.S.A.
KEUFFEL & ESSER CO.

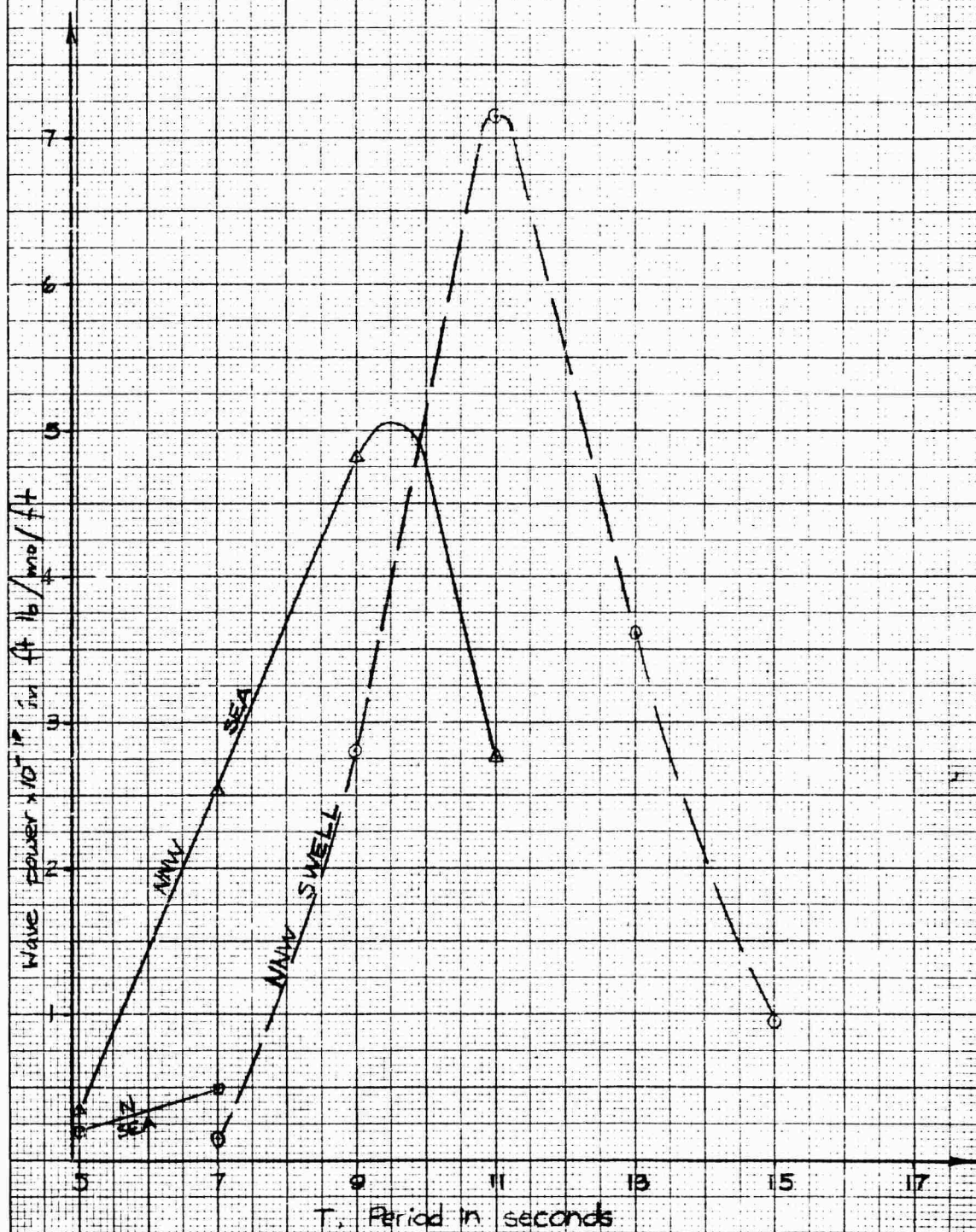
Total Monthly Wave Power, in ft-lb/mo/ft



WAVE POWER vs. PERIOD

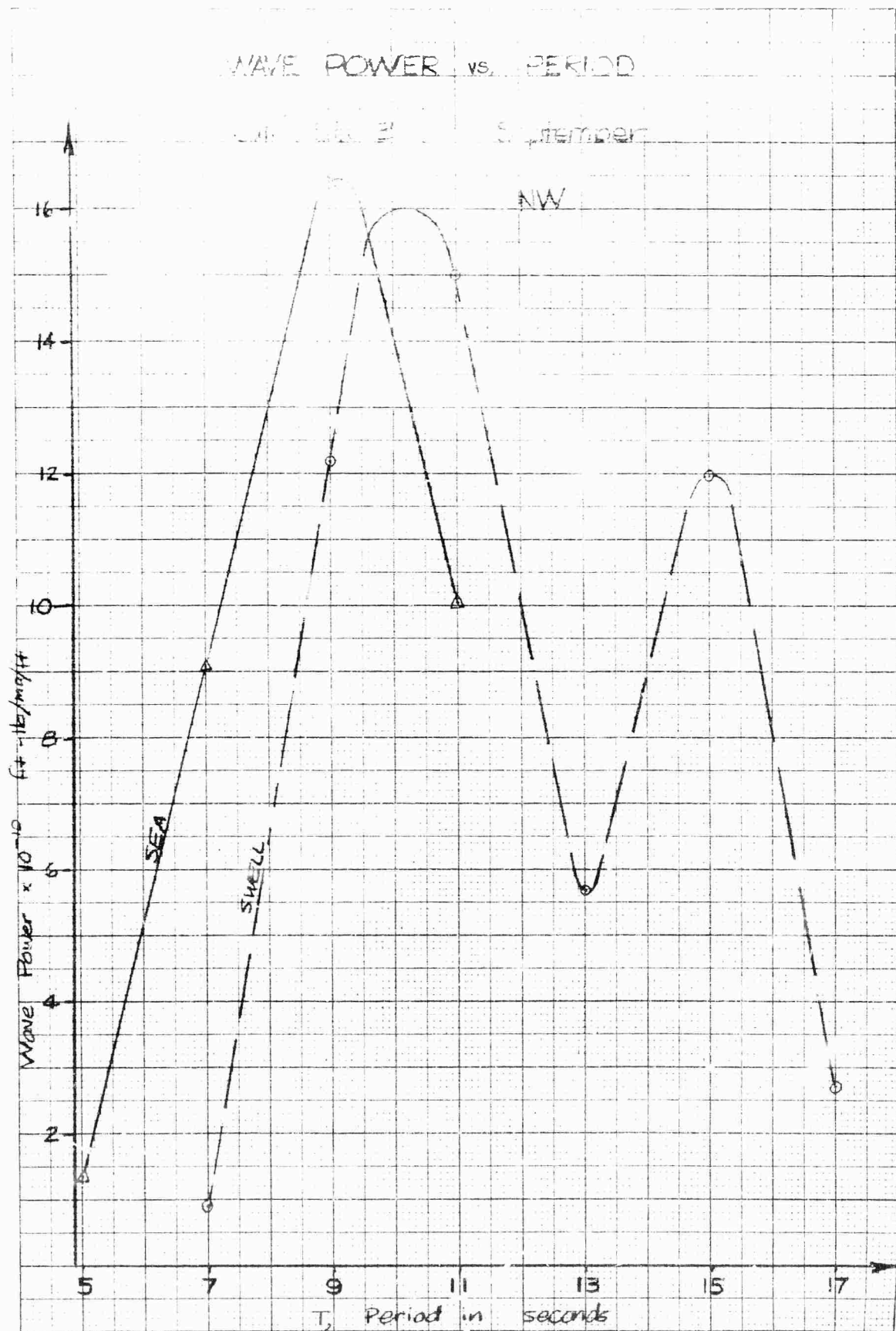
Calif S.W. 3 September

Directions: N, NNW

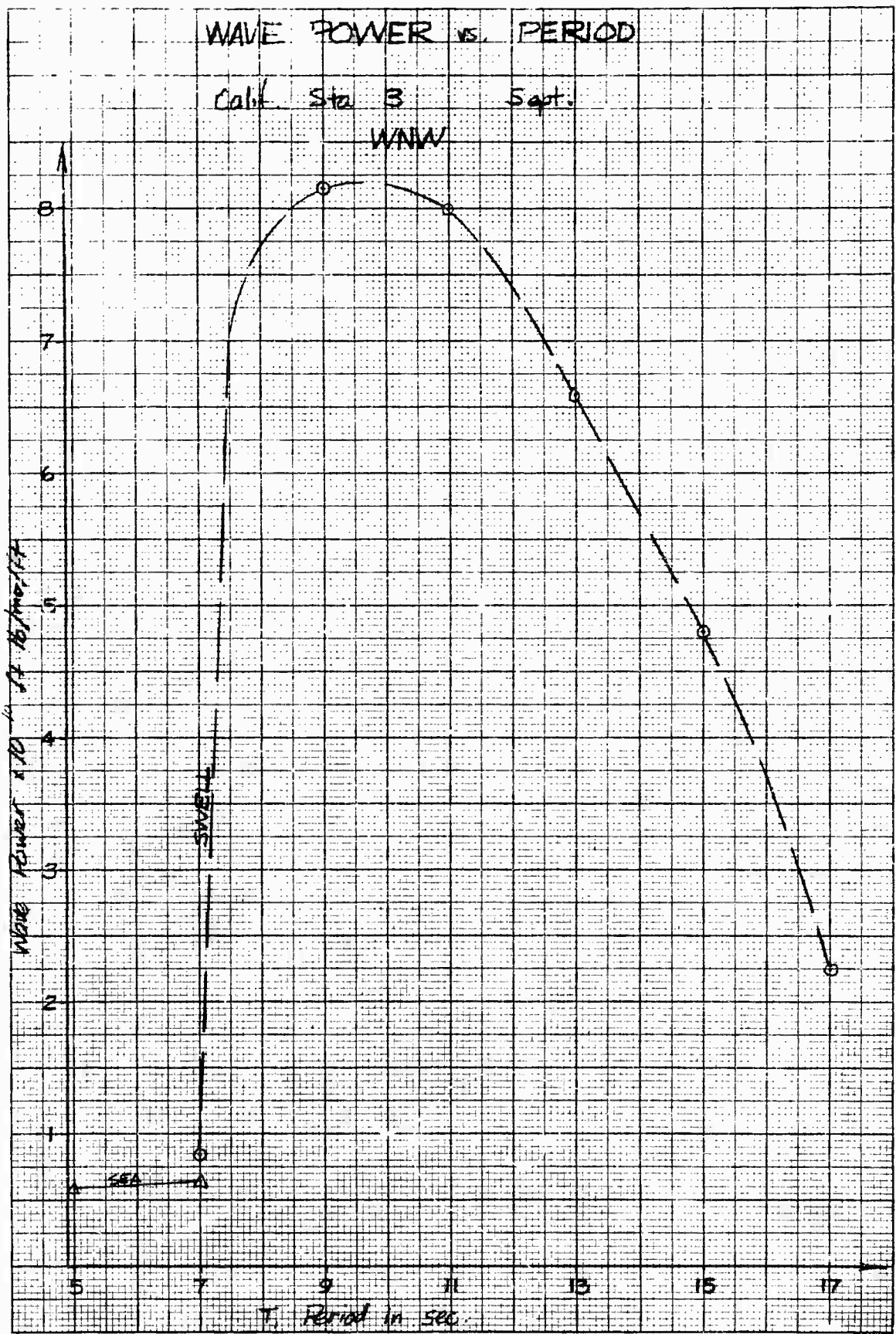


K&E 10 X 10 TO 1 1/2 INCH 46 1323
 7 X 10 INCHES MADE IN U.S.A.
 KEUFFEL & ESSER CO.

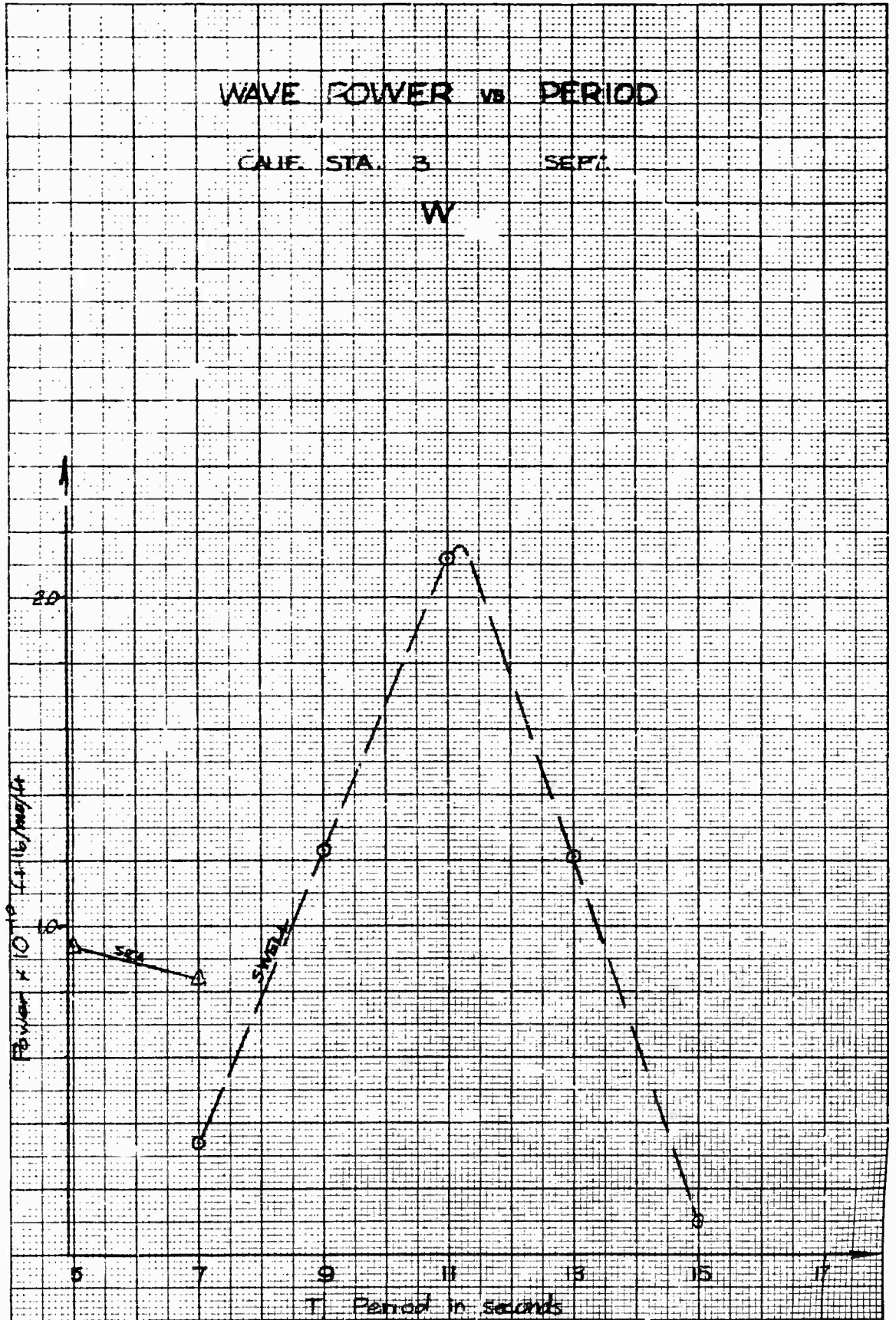
REF 10 X 10 TO 17 INCH 46 1323
 10 X 10 TO 17 INCH 46 1323
 10 X 10 TO 17 INCH 46 1323



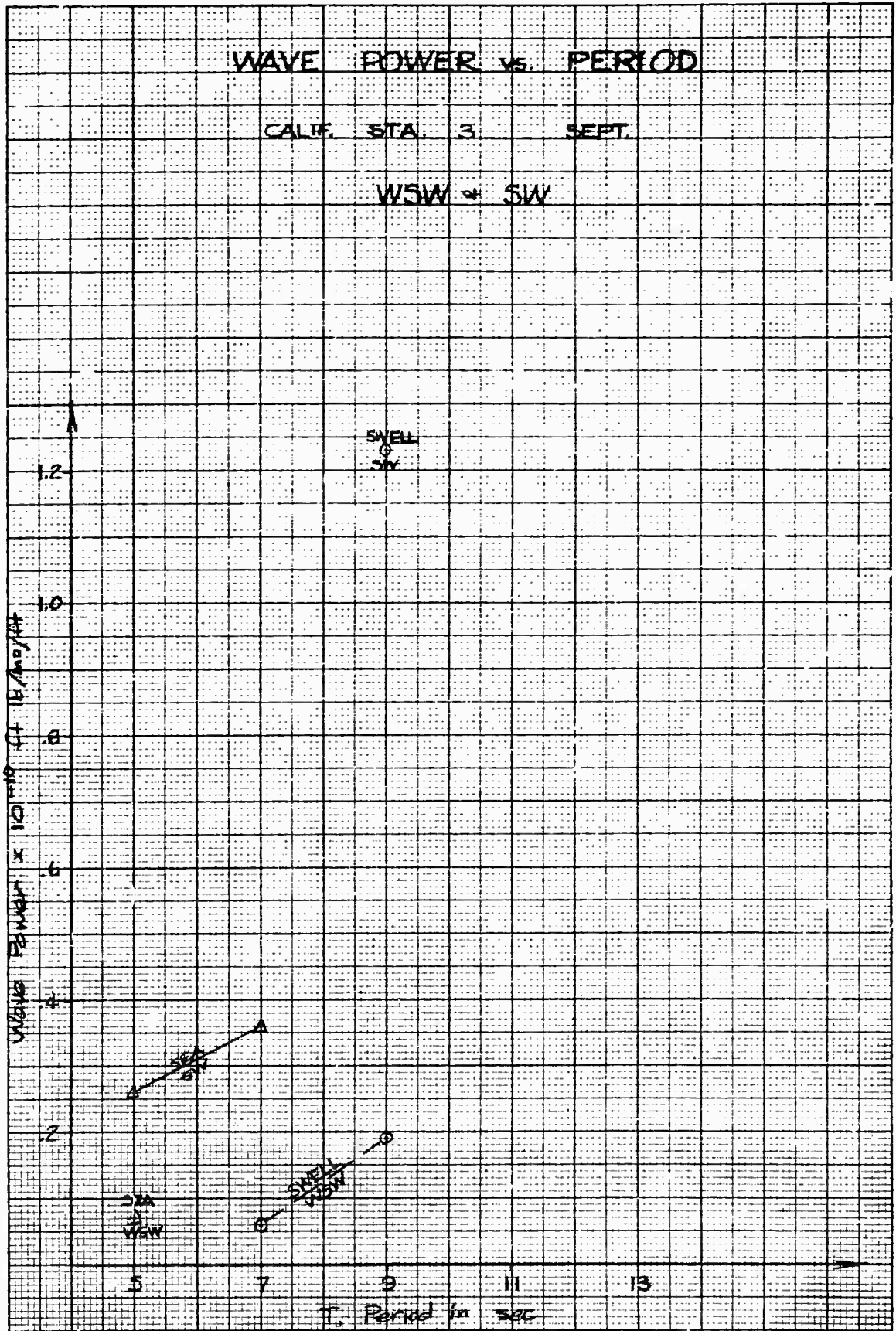
KE 10 X 10 TO 1 1/2 INCH 46 1323
MADE IN U.S.A.
KEUFFEL & ESSER CO.



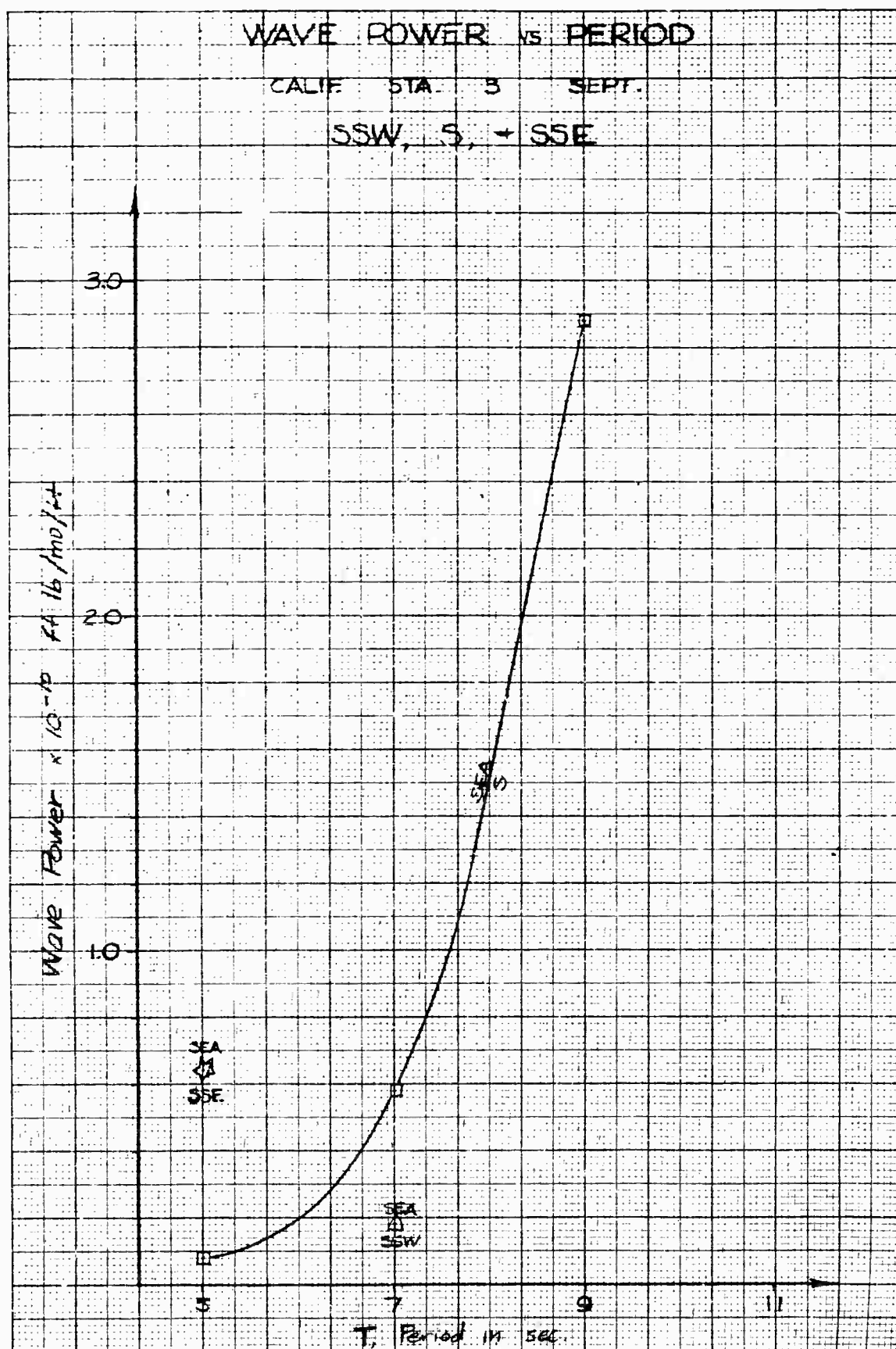
K&E 10 X 10 TO 1/2 INCH 461323
K&E PAPER CO. NEW YORK, N.Y.
K&E PAPER CO. NEW YORK, N.Y.



K&E 10 X 10 TO 1/4 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

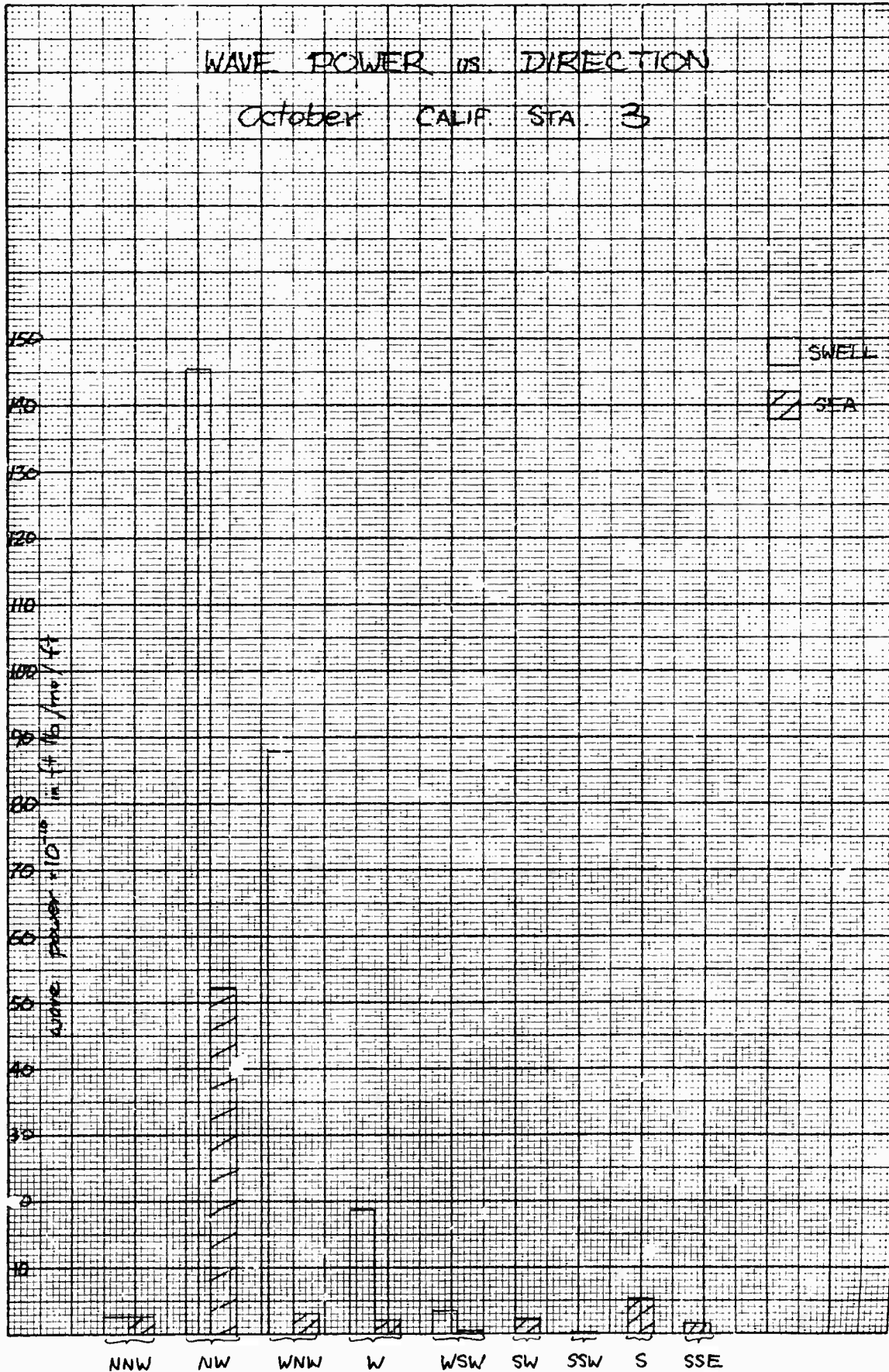


KE 10 X 10 TO 1 1/2 INCH 46 1323
 KODAK SAFETY FILM
 KODAK SAFETY FILM



STATION 3 - OCTOBER

K&E 10 X 10 TO 1/8 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



Wave Power vs. Wave Period

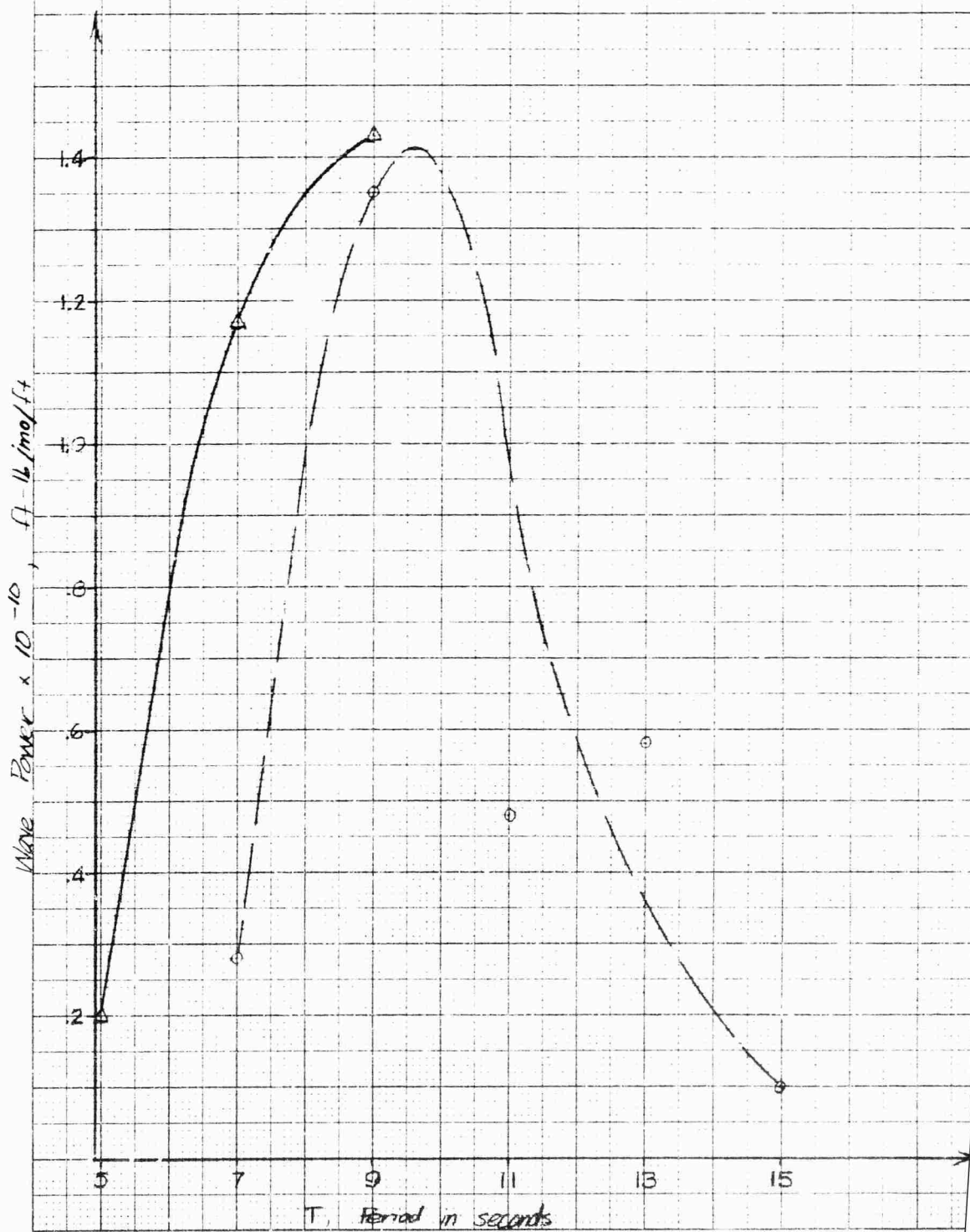
Calif. Sta. 3

October

NNW

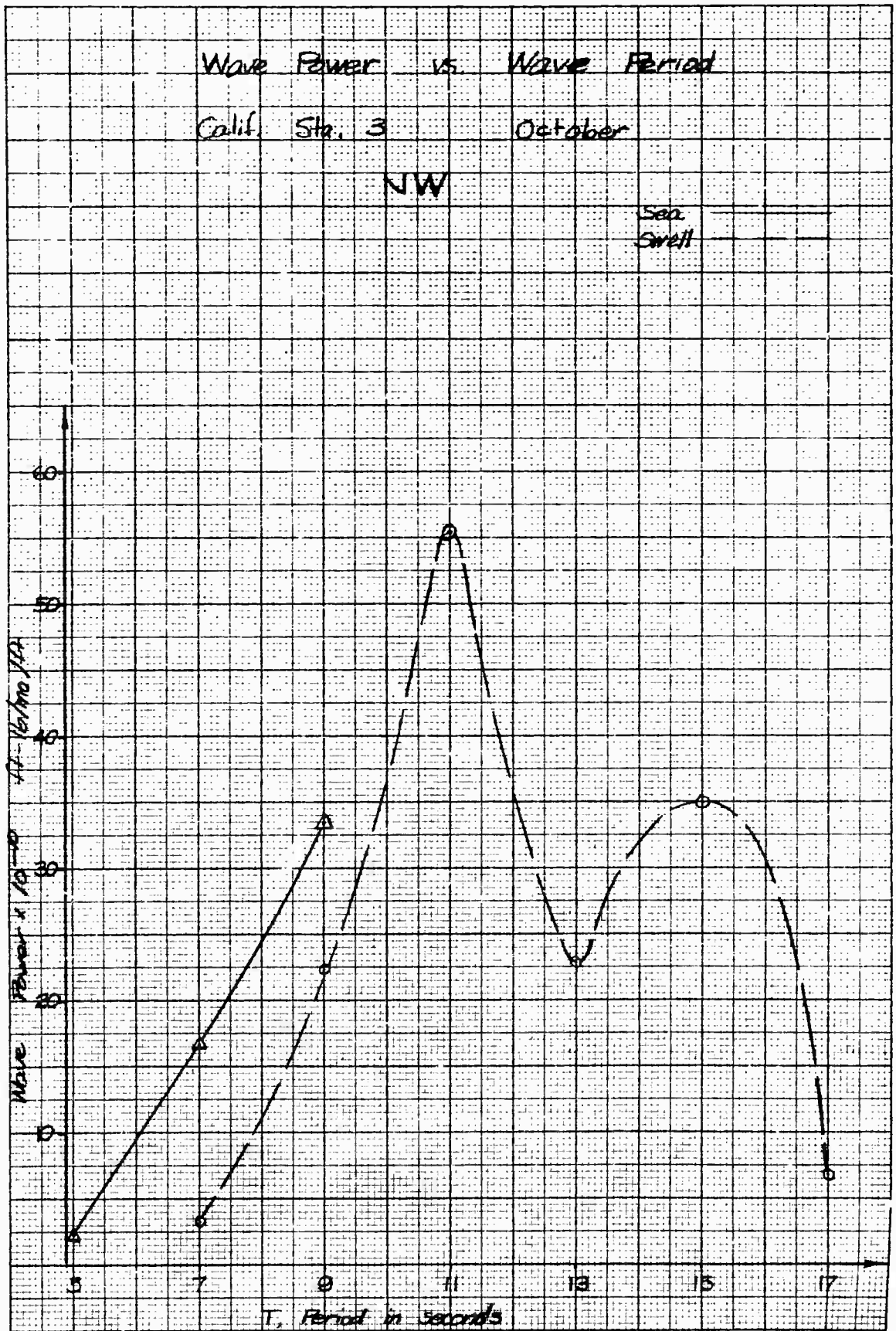
Sea ———

Swell ———



W. 7 1/2 x 10 to 1 1/2 INCH 45 1323
 W. 7 1/2 x 10 to 1 1/2 INCH 45 1323
 W. 7 1/2 x 10 to 1 1/2 INCH 45 1323

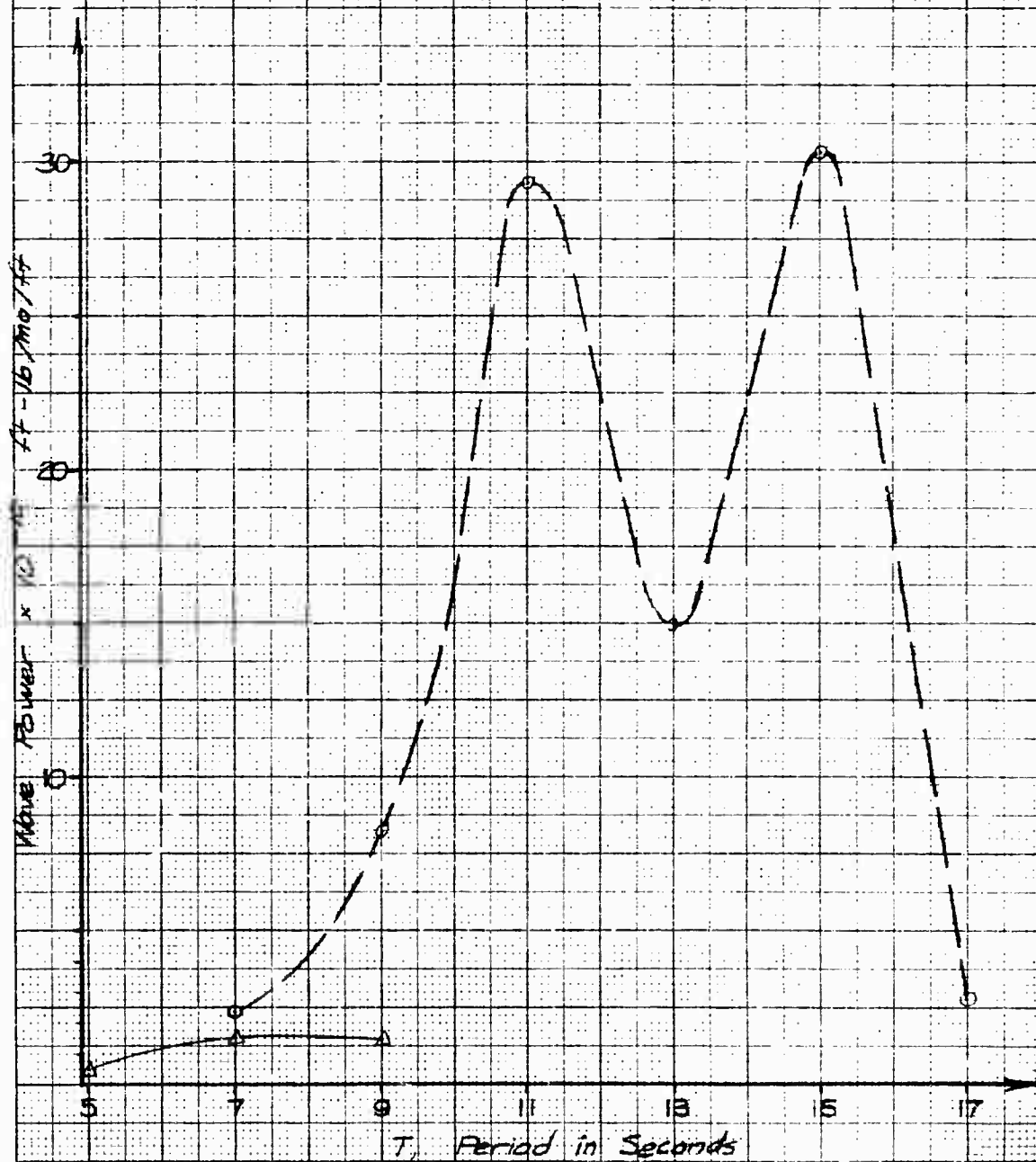
K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 1/2 INCHES
MADE IN U.S.A.
K&E PAPER & SUPPLY CO.



Wave Power vs Wave Period

Calif. Sta. 3 October

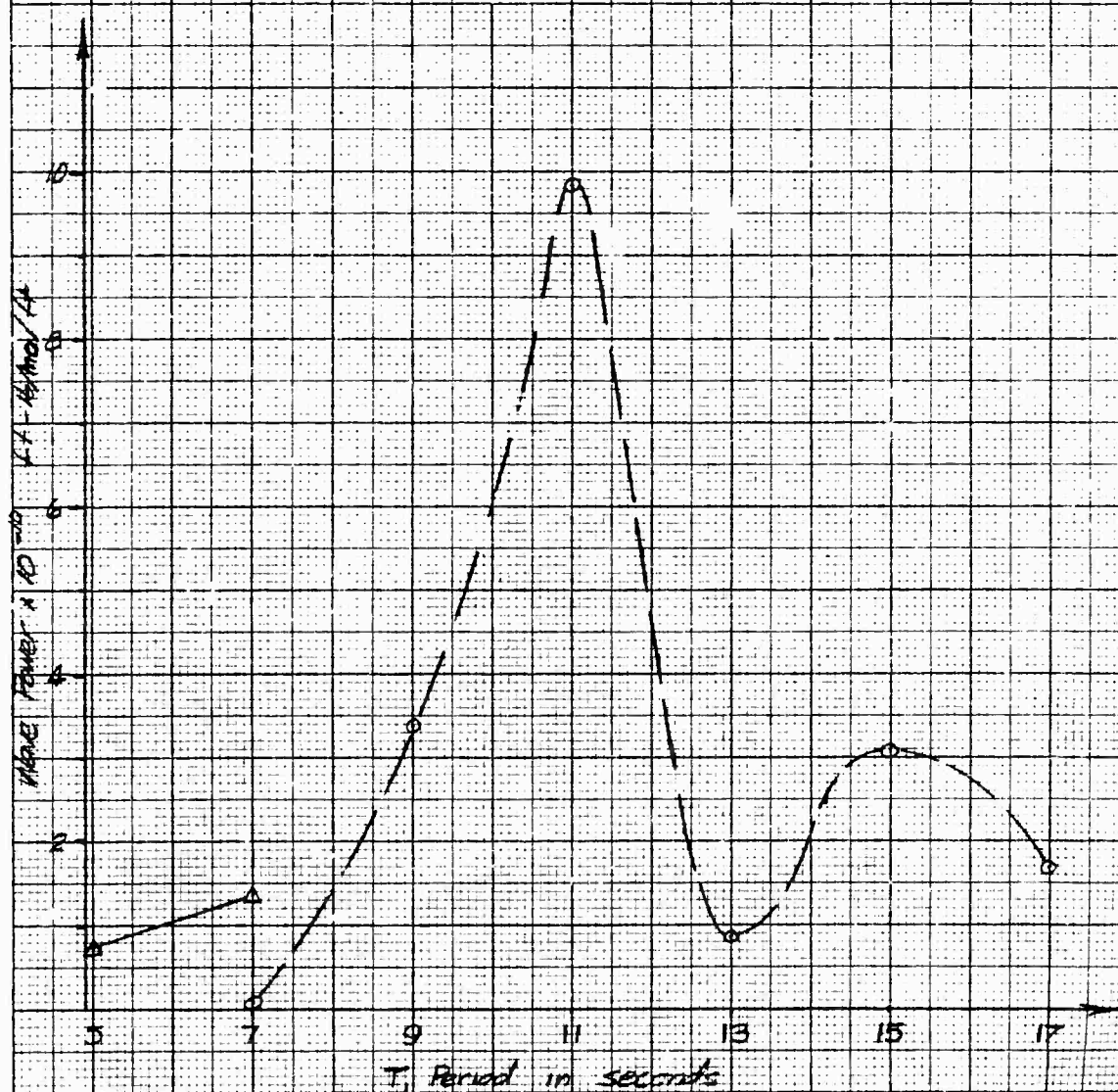
WNW

Sea ———
Swell — — —

Wave Power vs. Period
 Calif Sta. 3. October

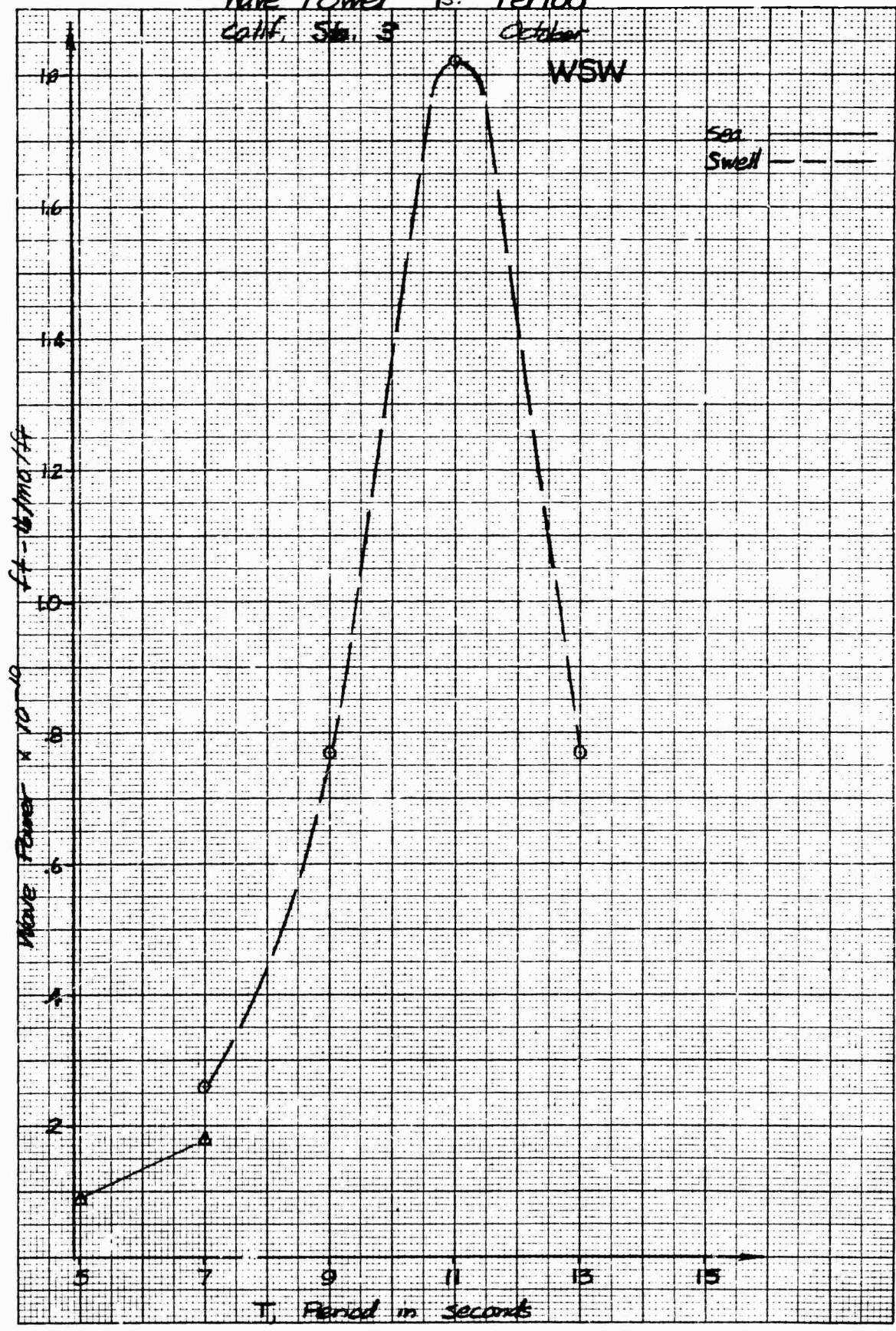
W

Sea —————
 Swell - - - - -



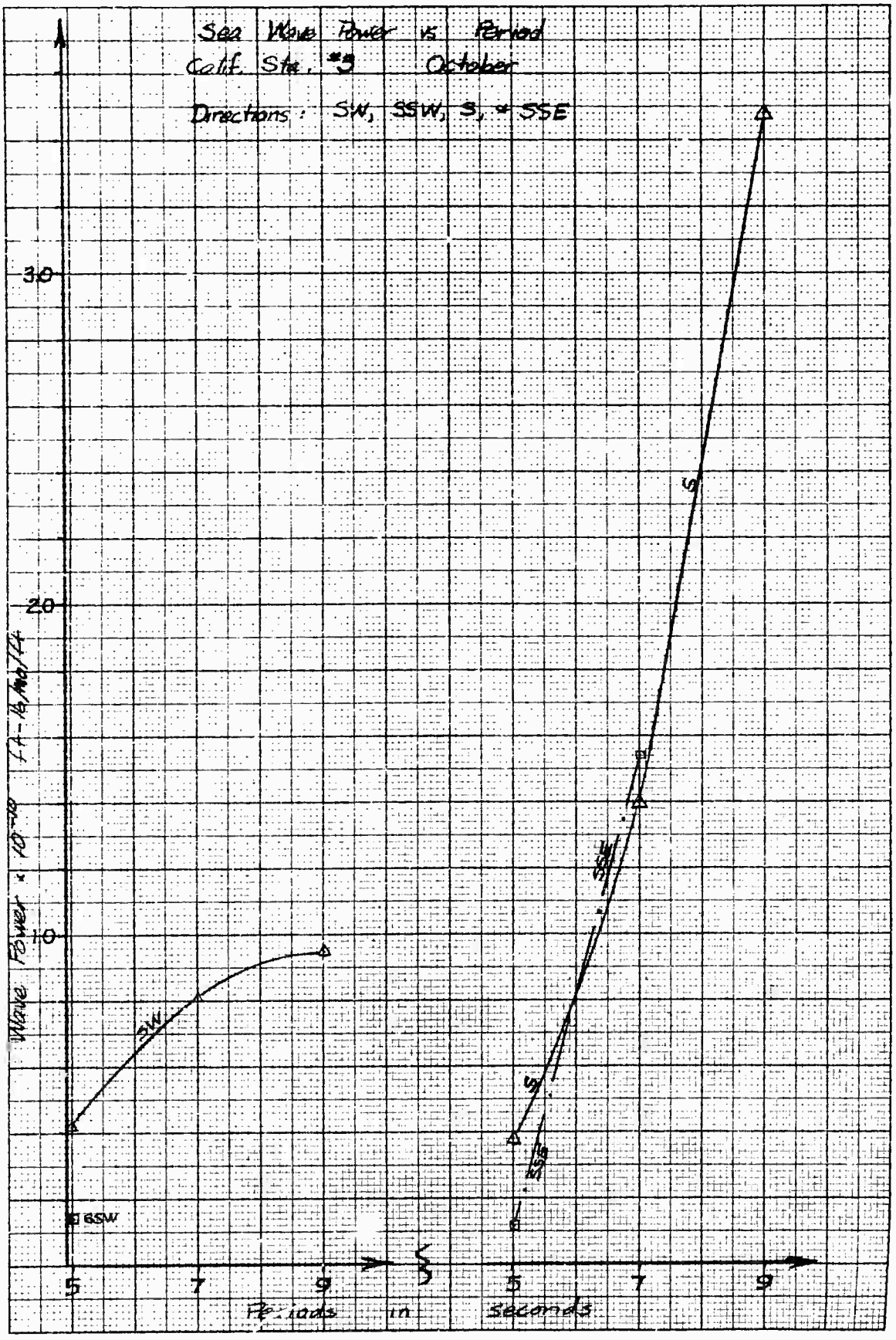
K-2 10 X 10 TO 1/2 INCH 46 1323
 KEUFFEL & ESSER CO.

Wave Power vs. Period
Calif. Sta. 3 October



K&E 10 X 10 TO 1/2 INCH 46 1323
1/4 TO INCHES
KEUFFEL & ESSER CO.

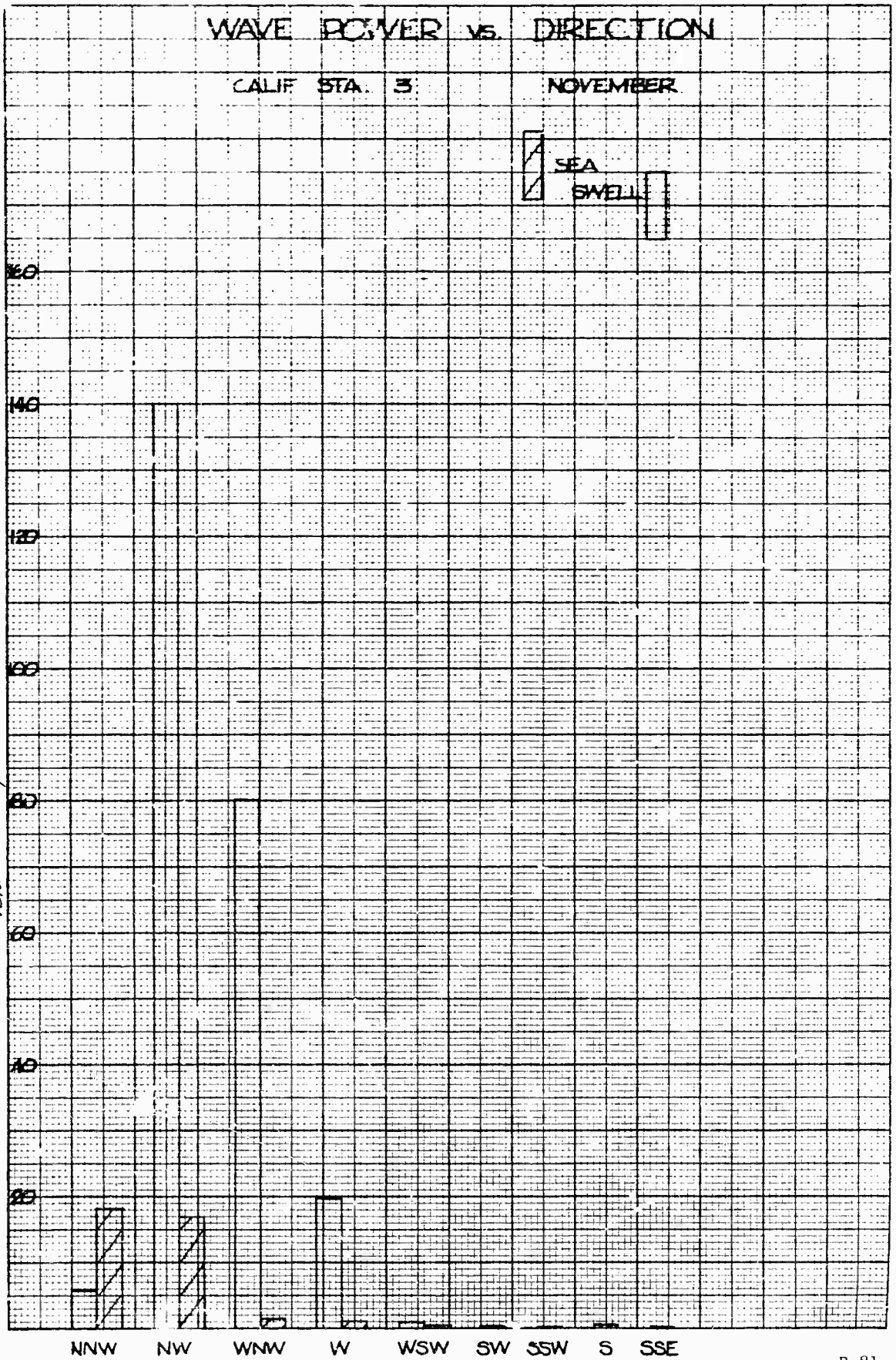
K&E 10 X 10 TO 1/2 INCH 46 1323
 U.S. GOVERNMENT PRINTING OFFICE: 1965
 NEFFEL & ENRIE & CO.



STATION 3 - NOVEMBER

K&E 10x10 to 1 1/2 inch 46 1323
7 x 10 INCHES
KEUFFEL & ESSER CO.

Total Monthly Wave Power x 10⁻¹⁰ ft-lb/month/ft

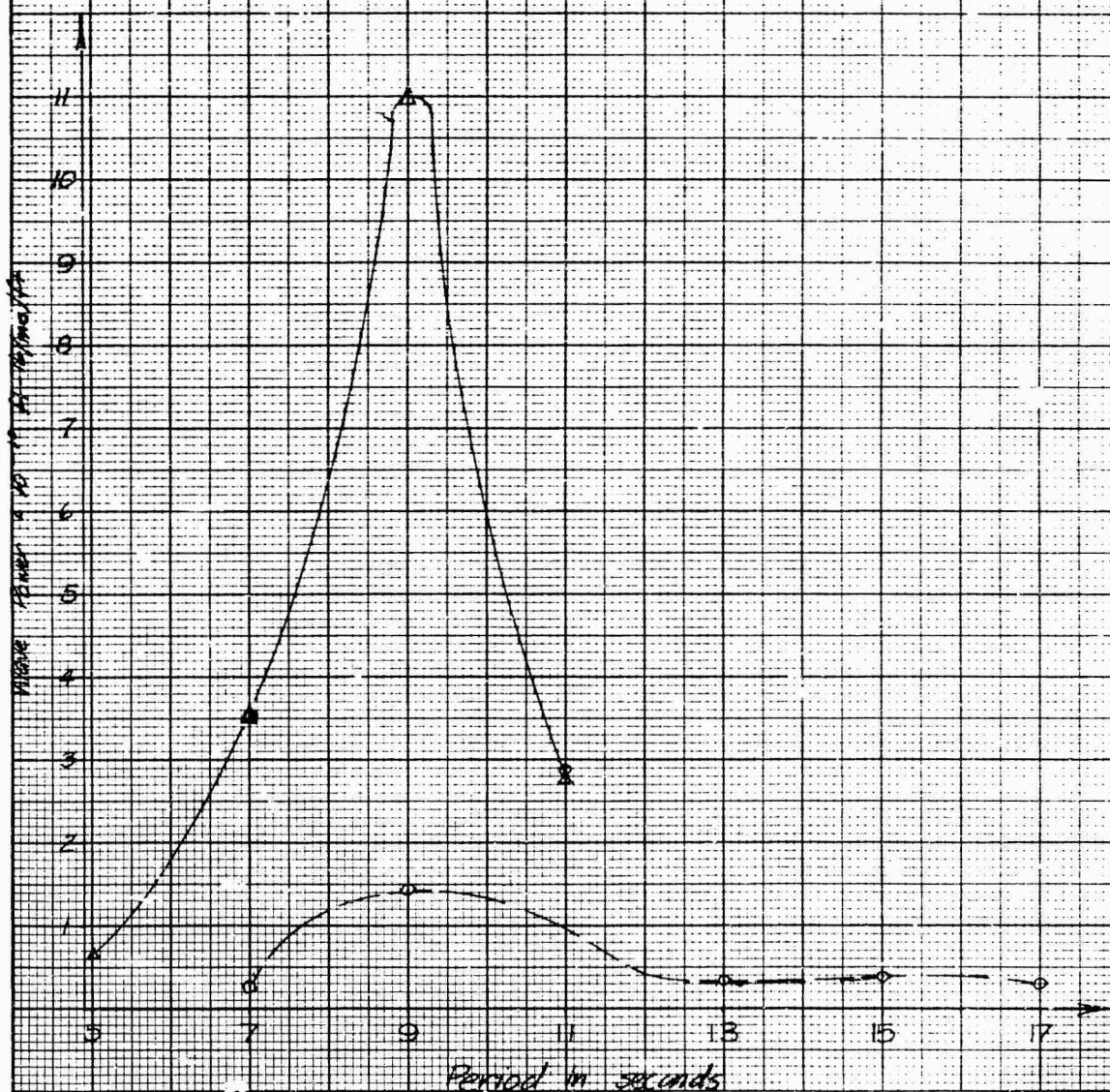


WAVE POWER VS PERIOD

CALIF. STA. 3

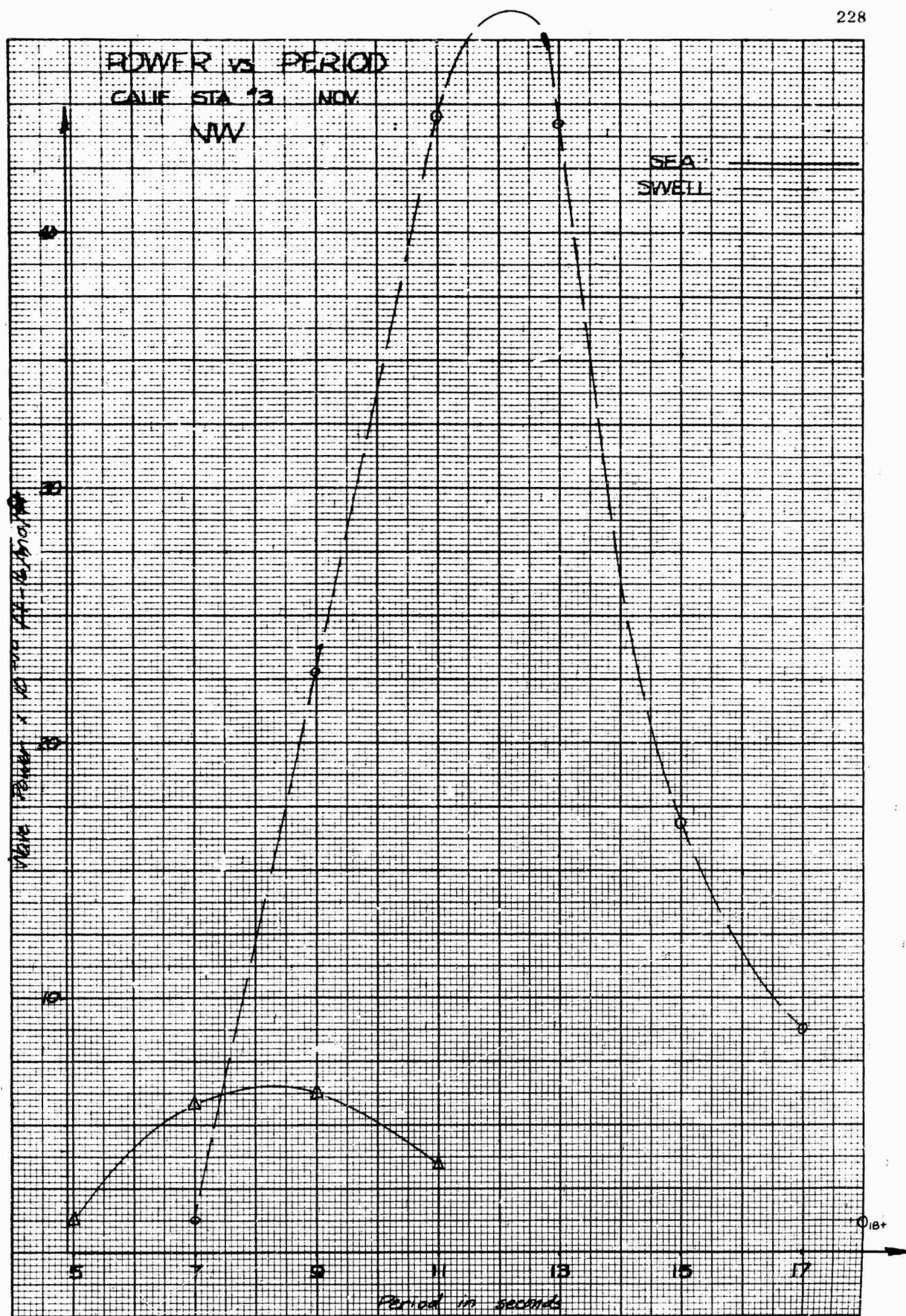
NOV.

NNW

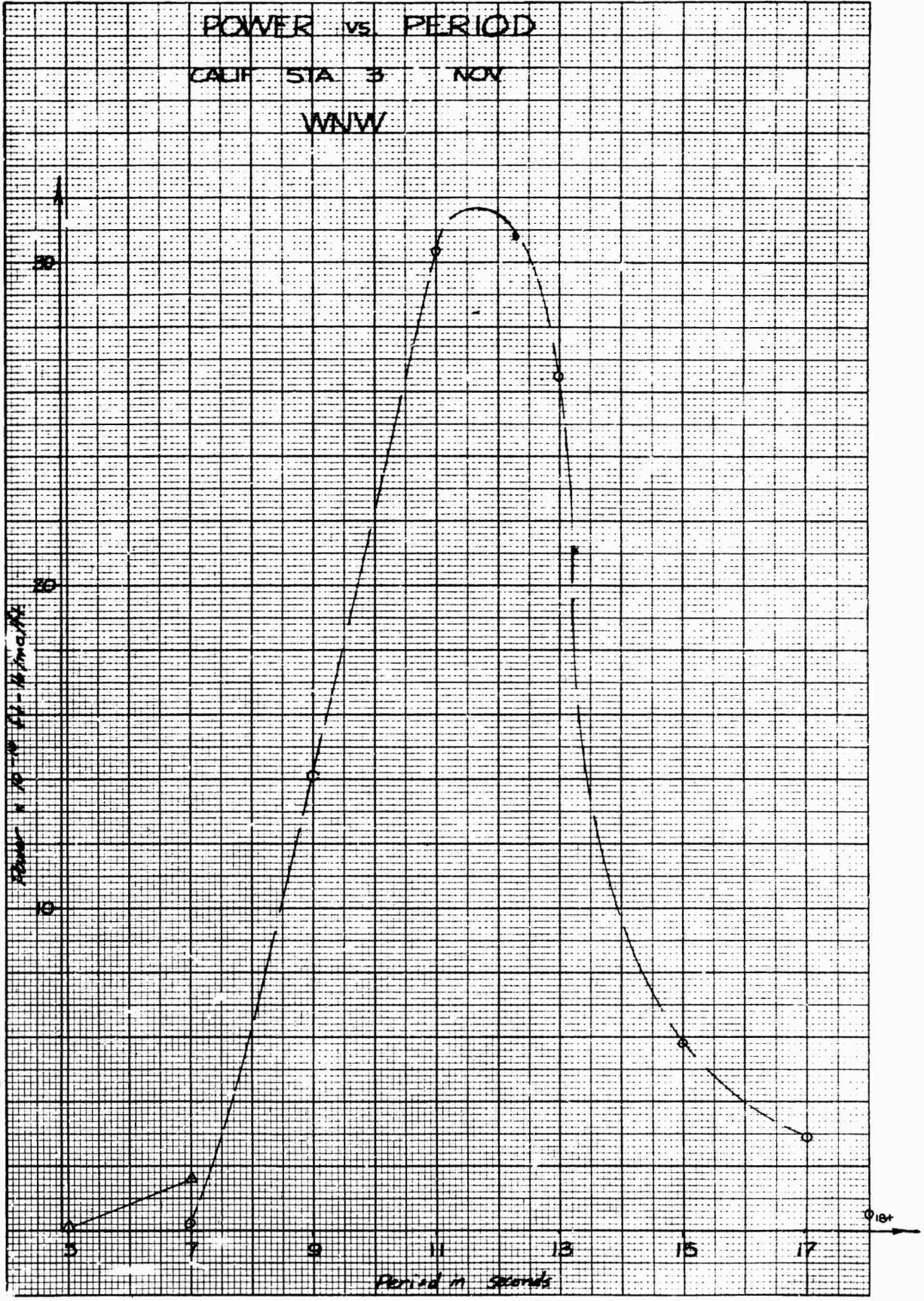
SEA
SWELL

K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

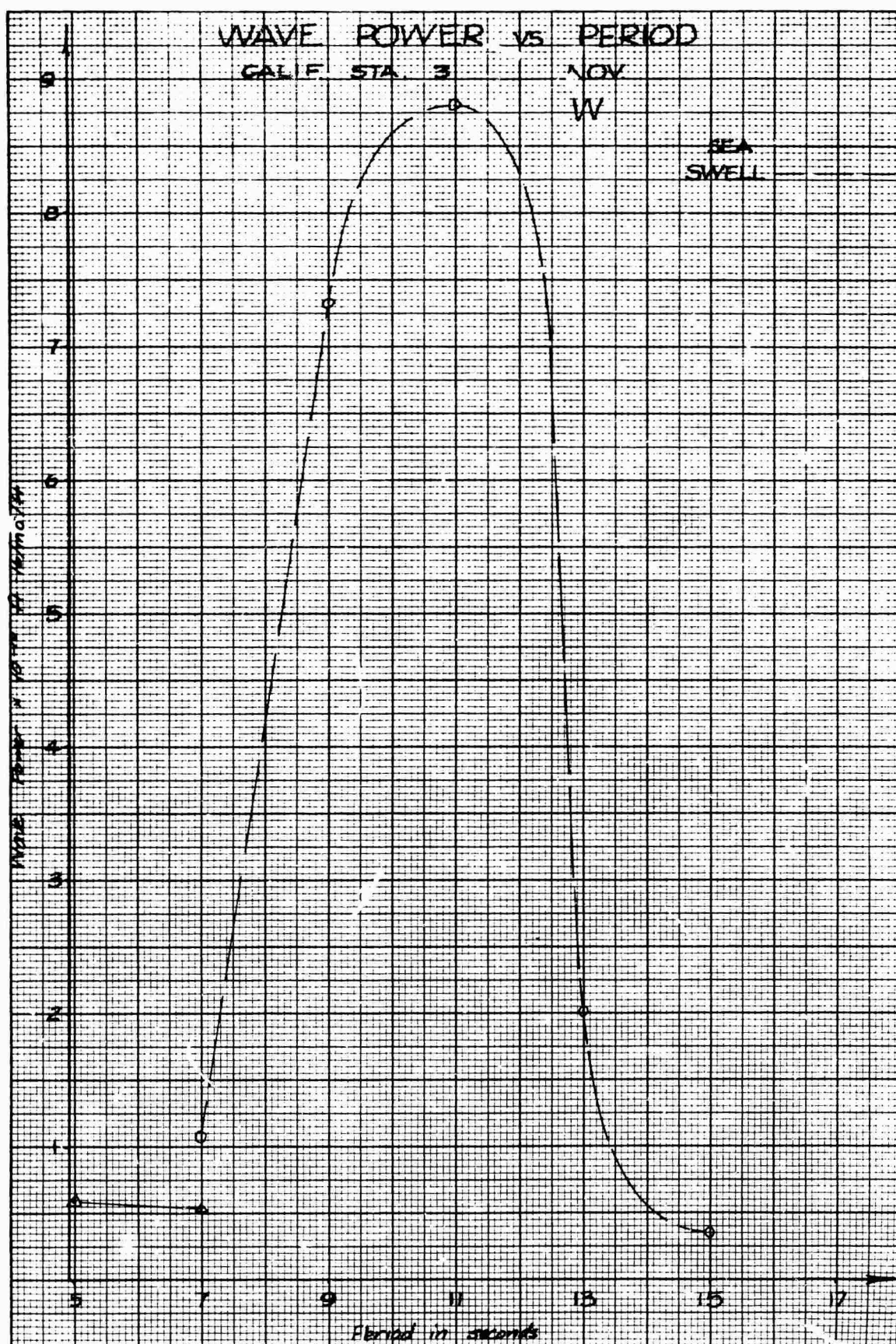
K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO



KE 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

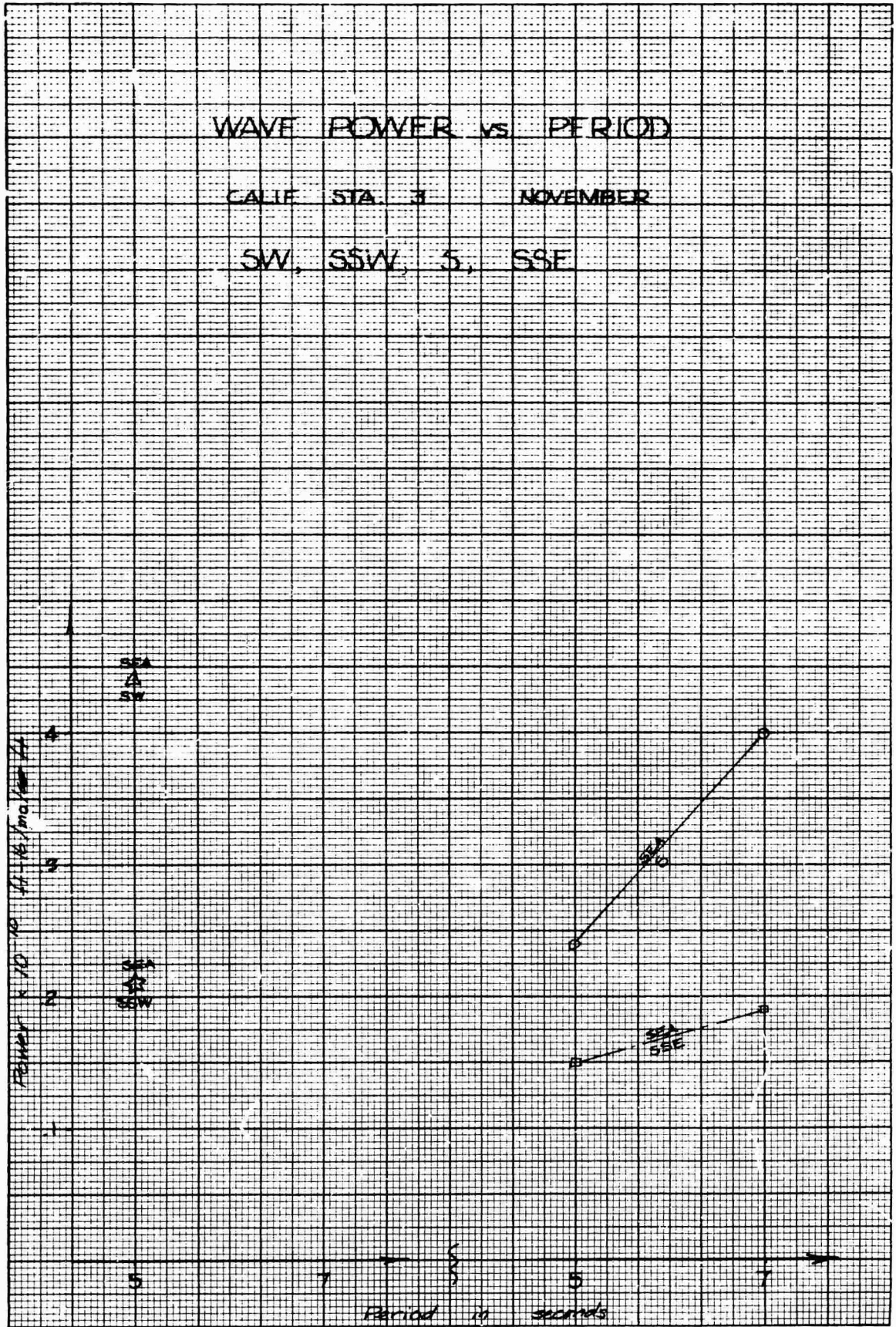


K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCH PAPER U.S.A.
Kruppel & Seiber Co.





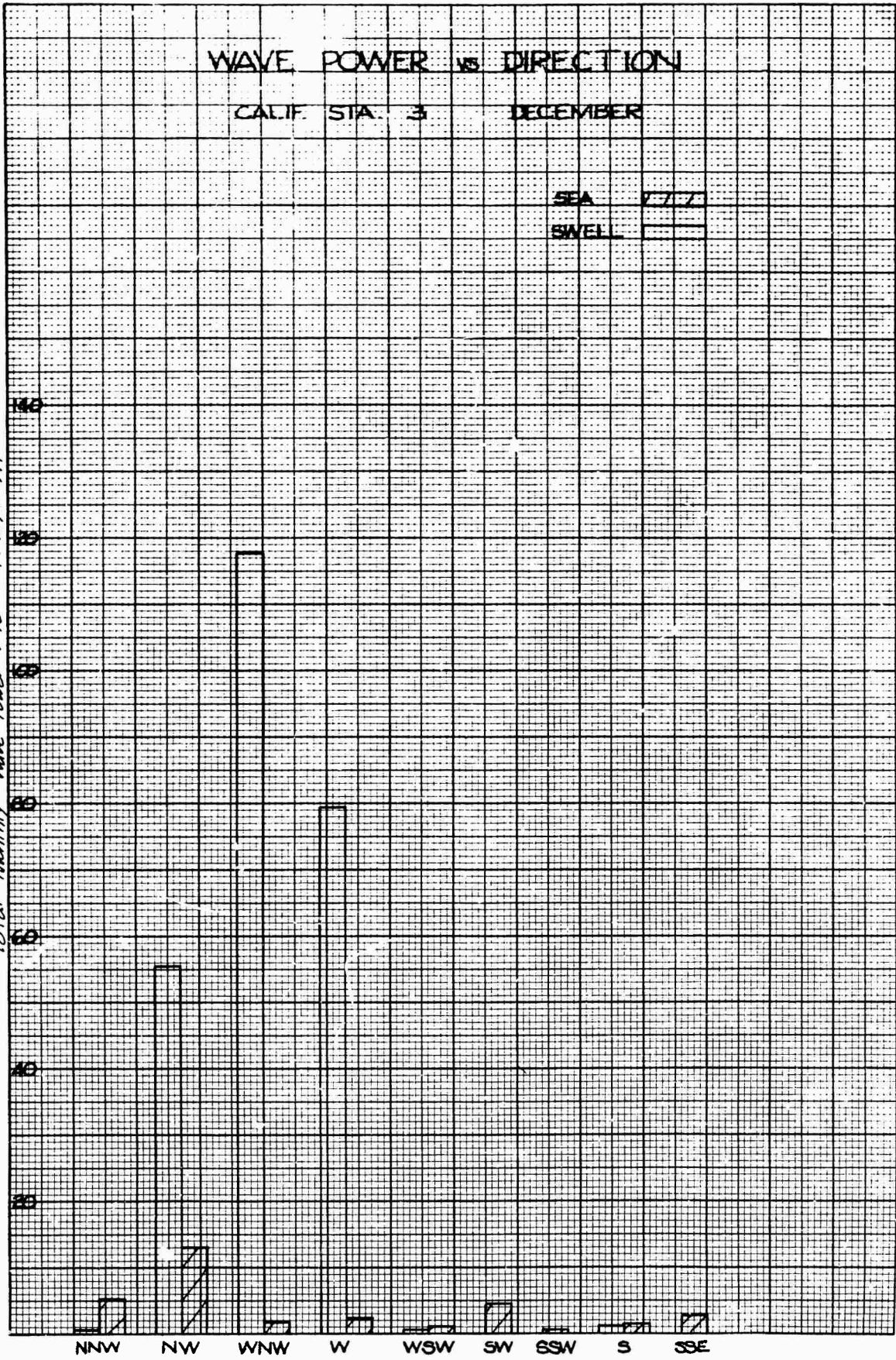
K-E 10 X 10 TO 1/4 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



STATION 3 - DECEMBER

K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.

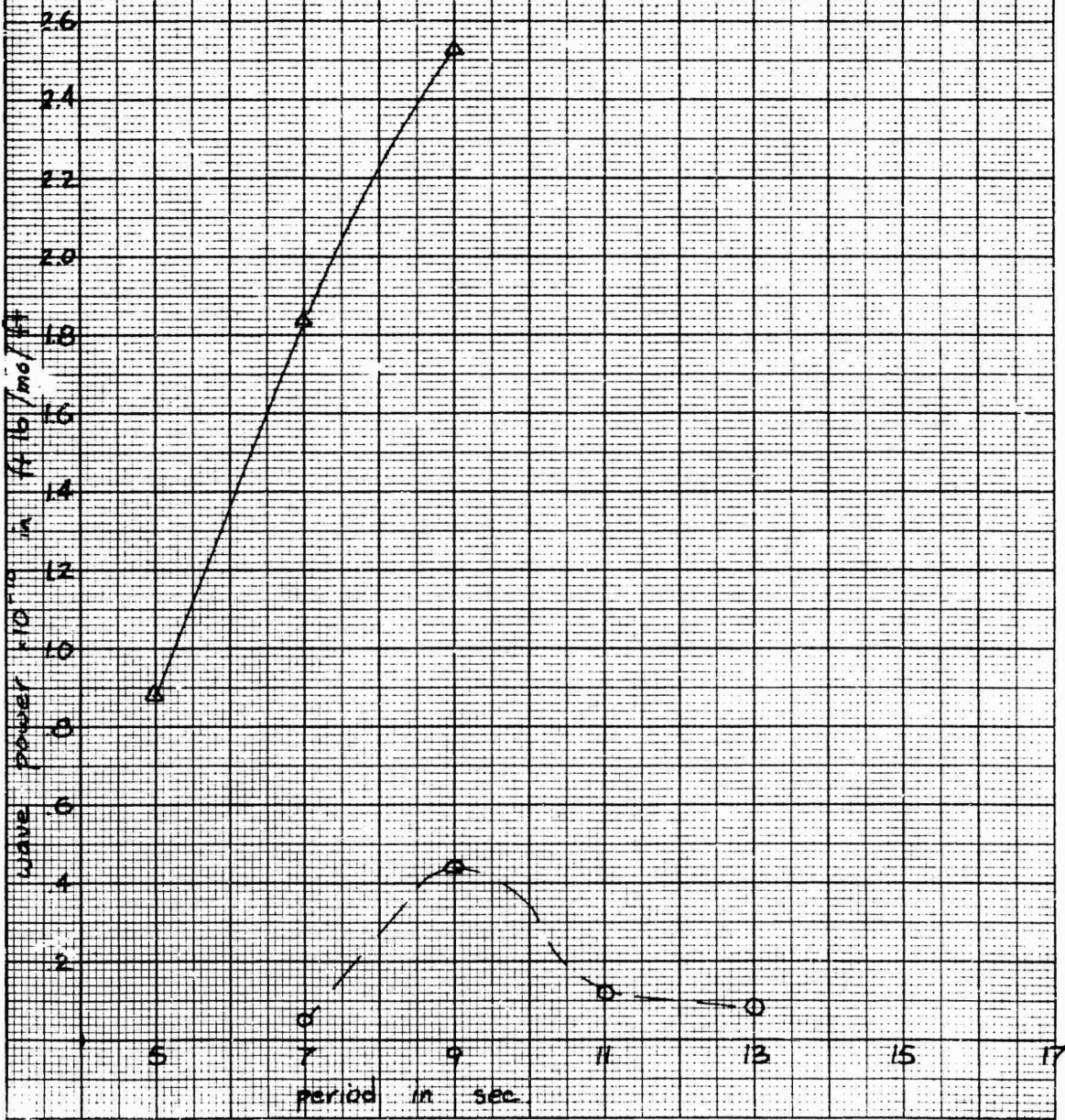
Total Monthly Wave Power x 10⁻¹⁰ ft¹⁶/min/ft



WAVE POWER vs PERIOD

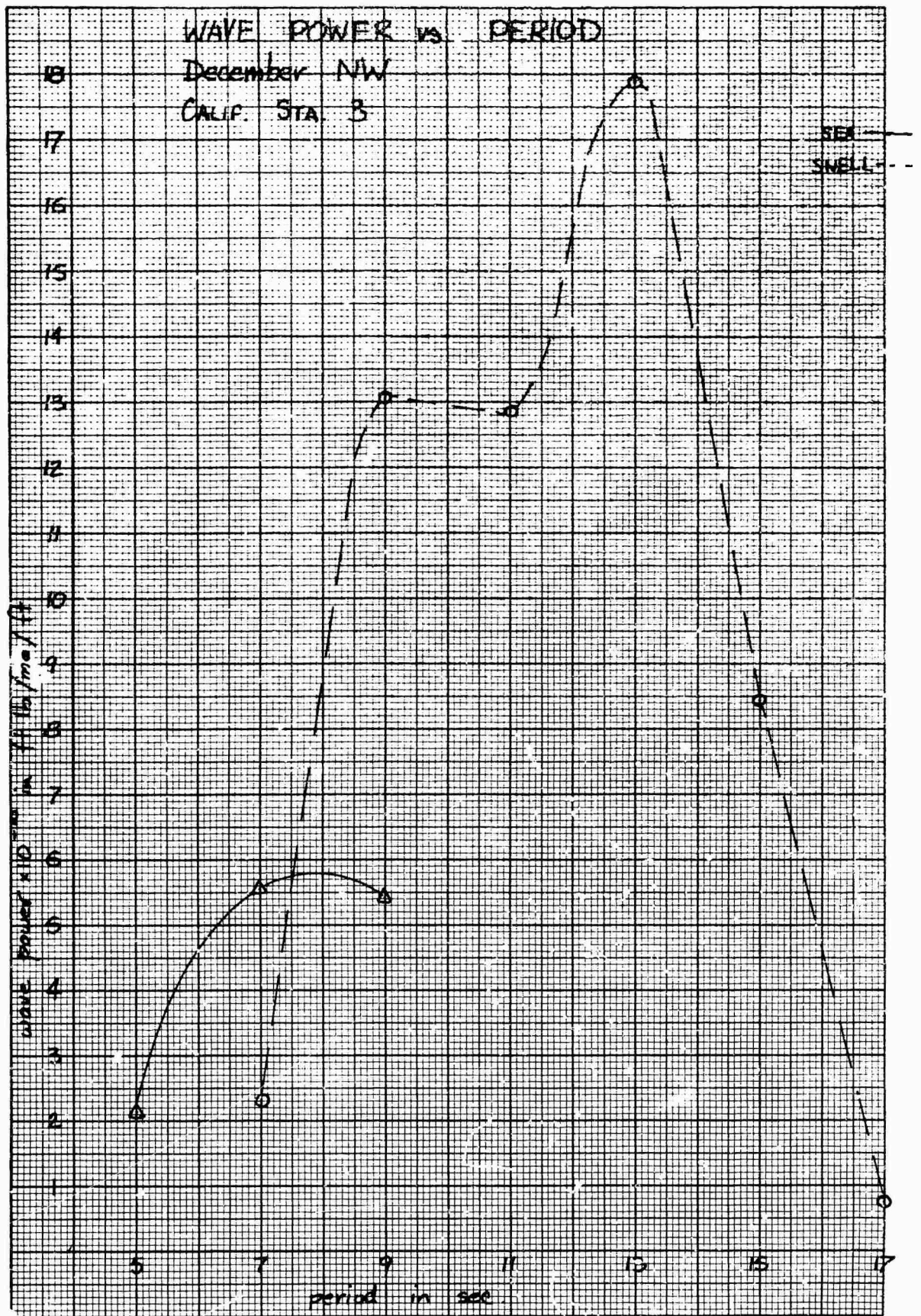
December NINW CALIF STA 3

SEA ———
SWELL - - - -

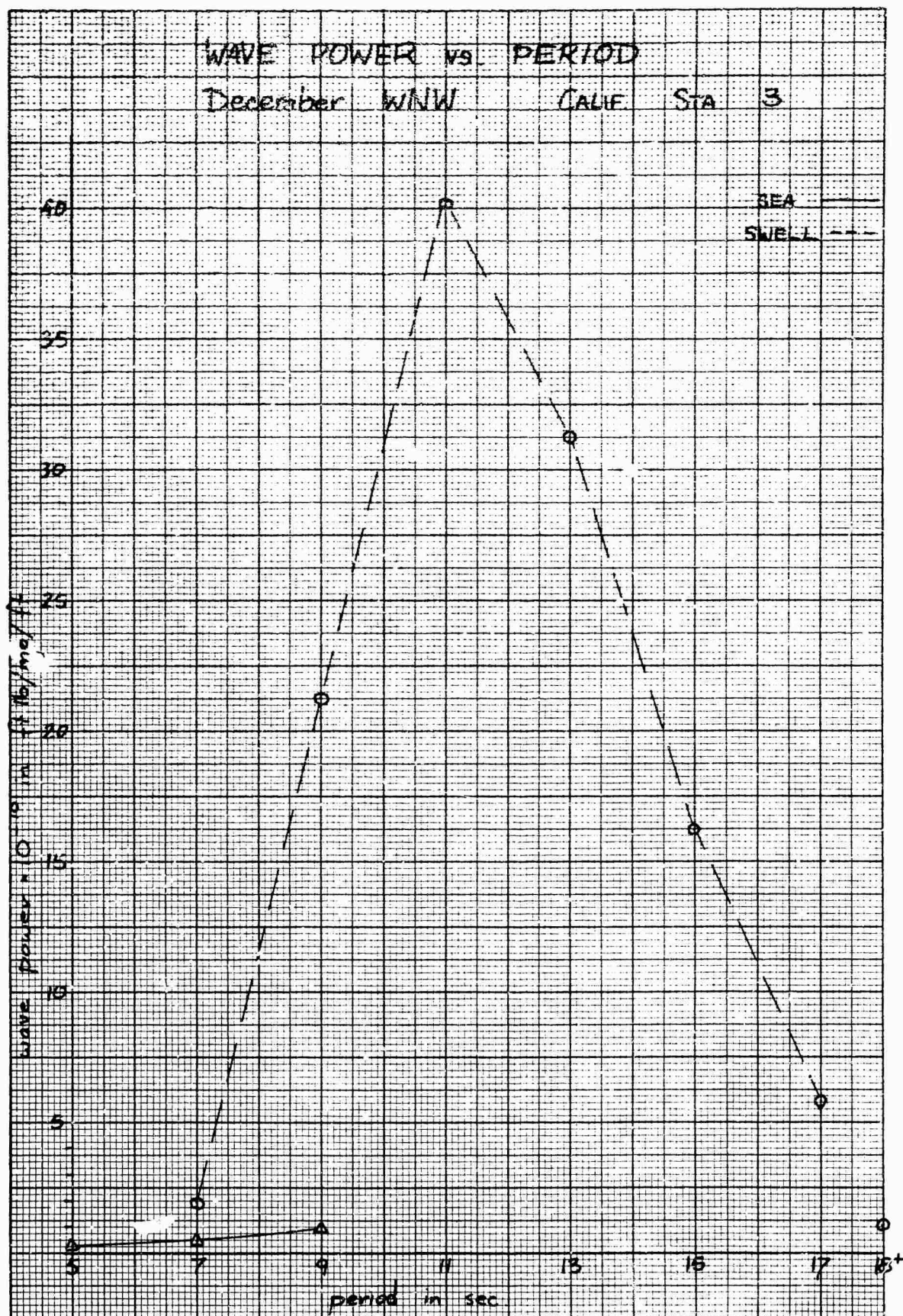


K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.

K-E 10 X 10 TO 1/2 INCH 46 1323
 7 X 10 INCHES
 MADE IN U. S. A.
 KEUFFEL & ESSER CO.

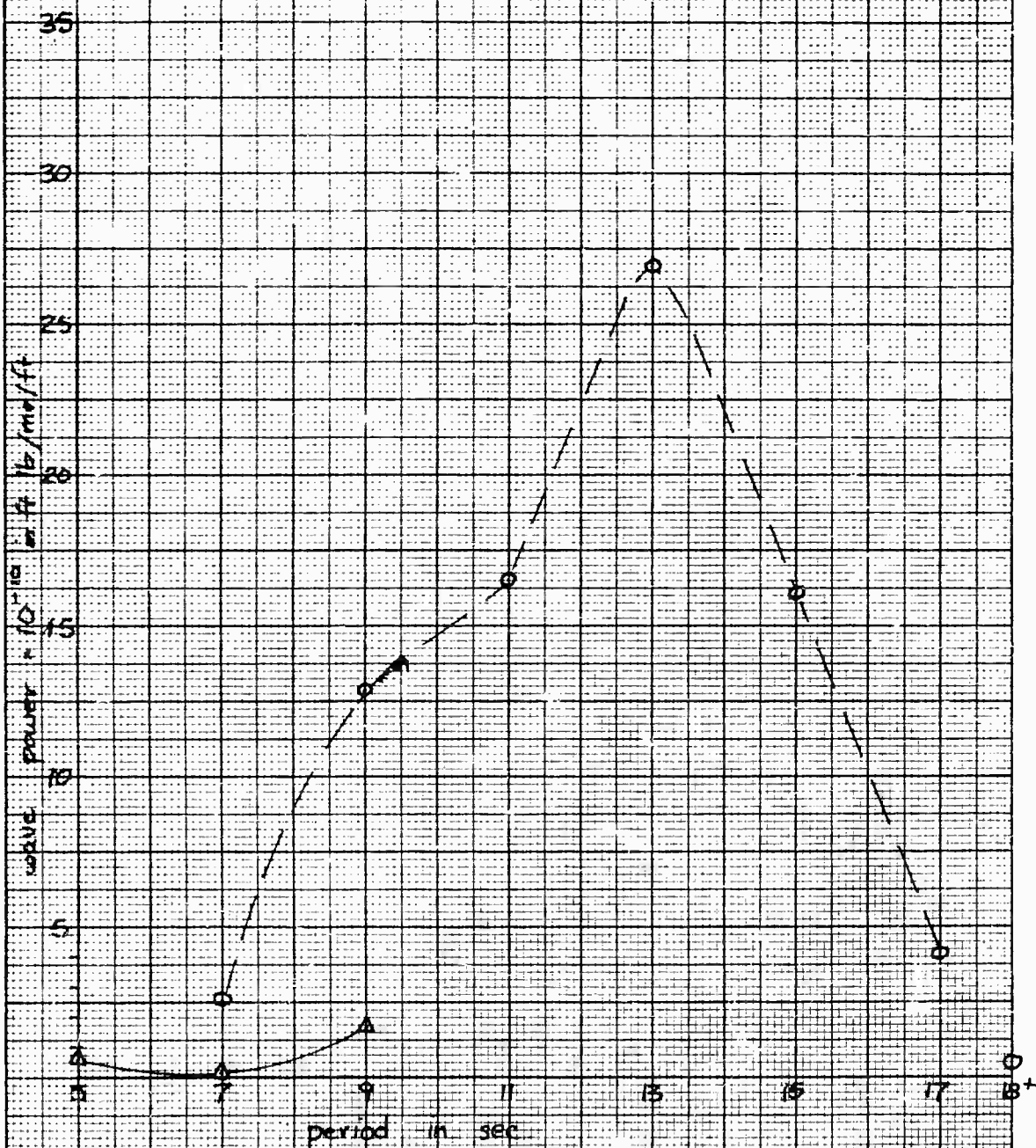


K&E 10 X 10 TO 1 1/2 INCH 49 1323
7 X 10 INCHES MADE IN U.S.A.
KEUFFEL & ESSER CO.



WAVE POWER vs PERIOD

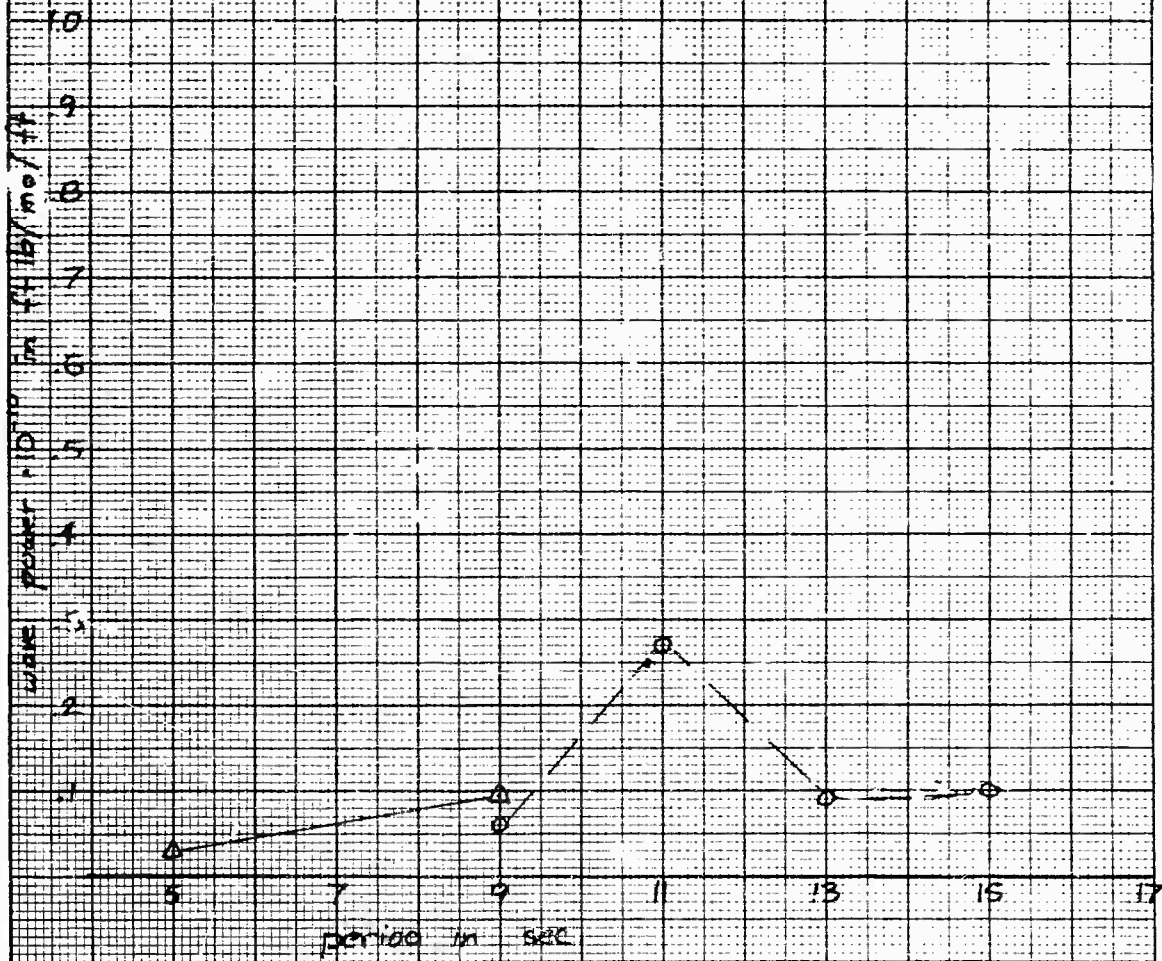
December W CALIF. STA. 3

SEA
SWELL

K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCH 46 1323
MADE IN U.S.A.
KEUFFEL & ESSER CO.

WAVE POWER vs PERIOD December WSW CALIF. STA. 3

SEA
SWELL



K&E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCH MADE IN U.S.A.
KEUFFEL & ESSER CO.

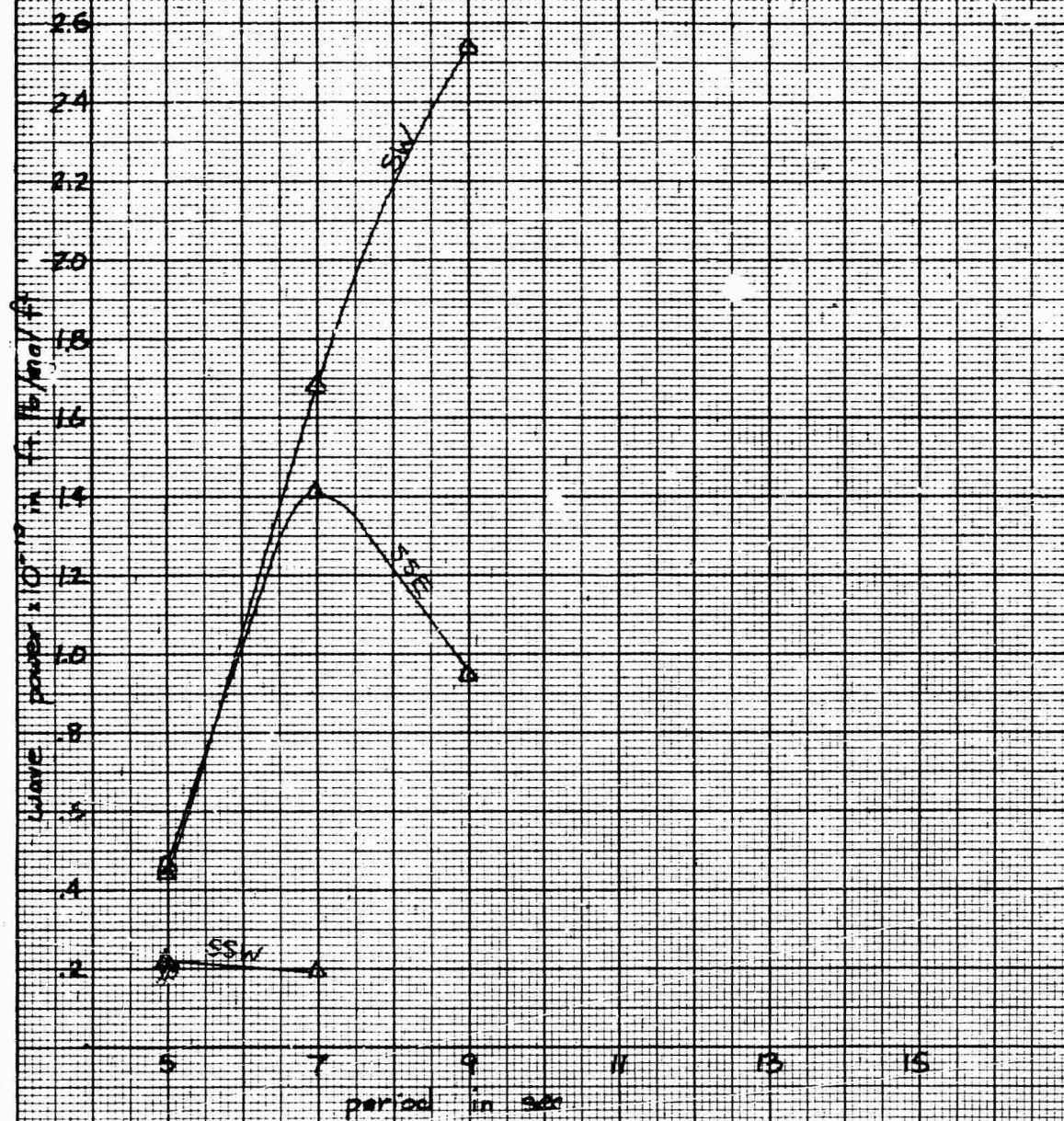
WAVE POWER vs PERIOD

December SW, SSW, SSE

CAVE STA 3

SEA

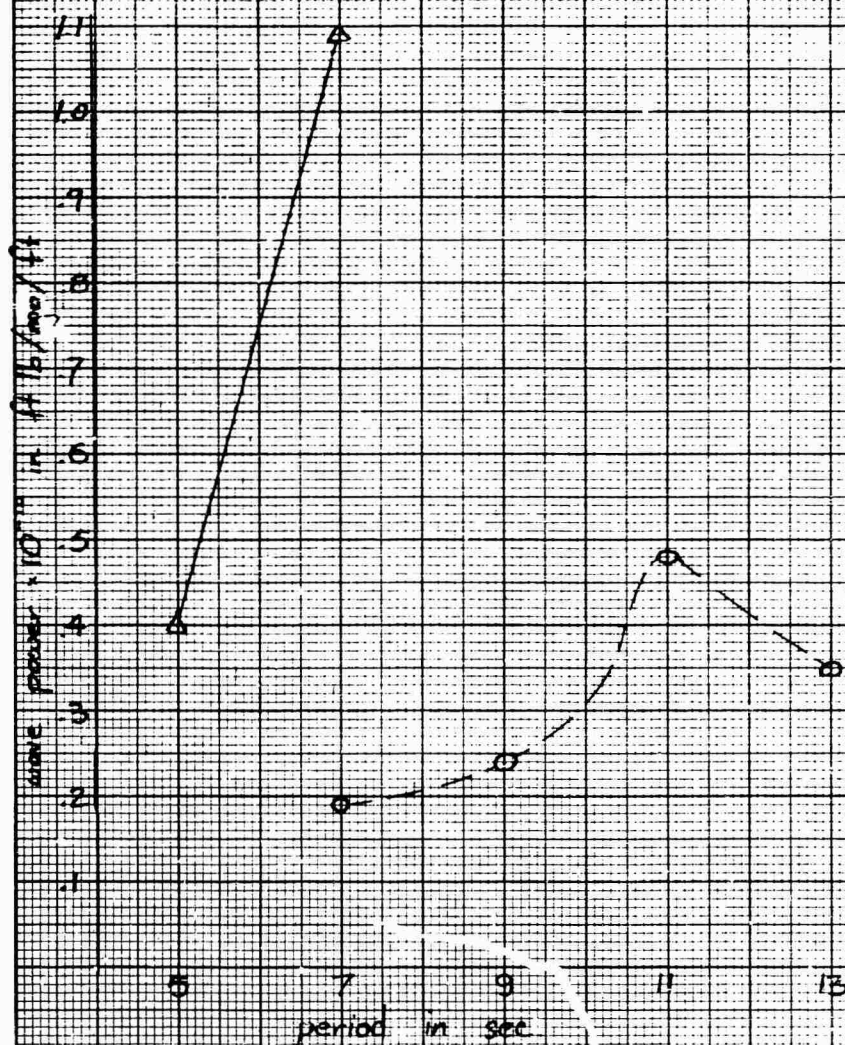
SWELL



10 x 10 TO 1/2 INCH 46 1323
 7 x 10 INCHES MADE IN U.S.A.
 KEUPPEL & EBER CO.

WAVE POWER vs PERIOD

December 8 CALIF. STA. 3

SEA —
SWELL —K-E 10 X 10 TO 1/2 INCH 46 1323
7 X 10 INCHES
MADE IN U.S.A.
KEUFFEL & ESSER CO.